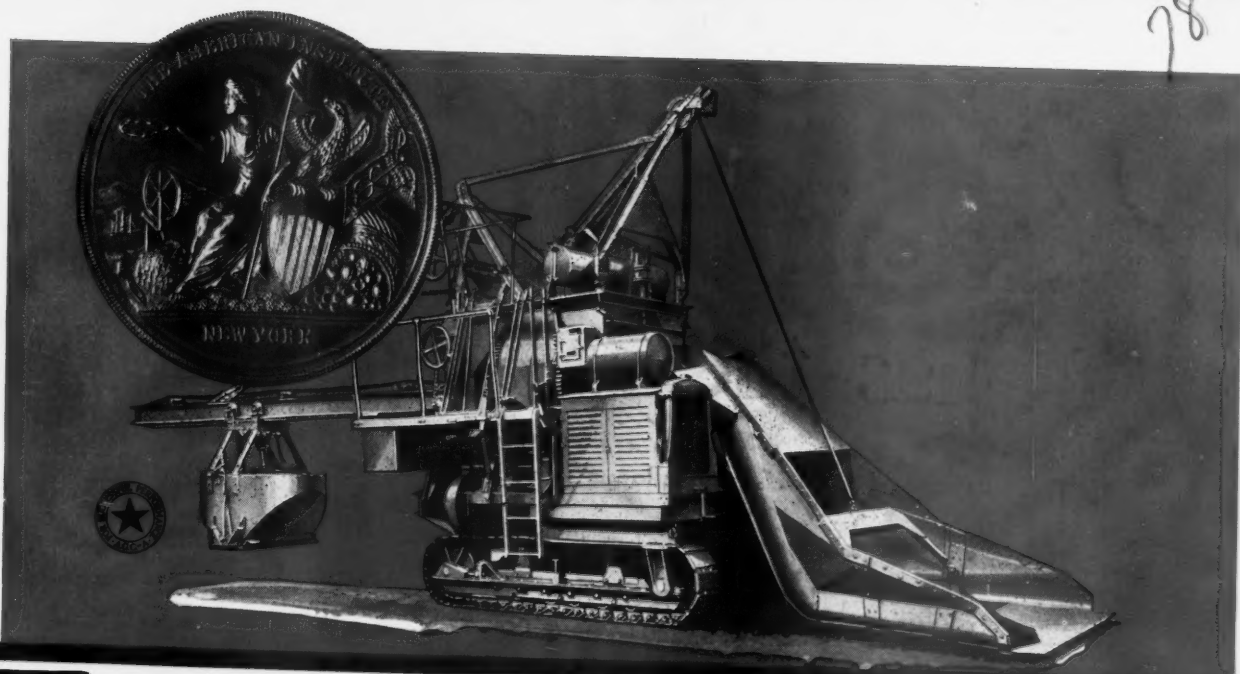


Pit and Quarry

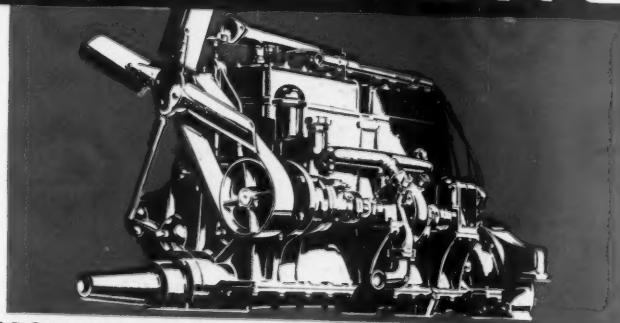
SAND-GRAVEL-STONE
CEMENT-LIME-GYPSUM



***Foot* Pavers**

and

HERCULES ENGINES



HERCULES MOTORS CORPORATION, CANTON, OHIO, U. S. A.



Who has the greater liability?

LET us say, that two of your fellow pit owners buy cranes for use in their pits.

One buys solely on price, thinking that by making a saving on the first cost he saves in the long run.

The other looks not only at the purchase price but at uninterrupted service over a long period of time and buys an INDUSTRIAL All Purpose Crawler.



Perhaps the first man doesn't stop to reflect on the possibility of his repair bill and the resulting waste of time, making the cost of his crane greater in the long run.

Perhaps he doesn't realize that the facilities and economical production methods of the INDUSTRIAL WORKS make it possible to sell the INDUSTRIAL All Purpose Crawler at a price as low as any manufacturer whose price is consistent with quality and long uninterrupted, efficient service with a minimum of upkeep expense.



When you buy a crawler machine think of these two men. Which has the greater liability?

Crawling Tractor Cranes, Shovels, Draglines, Locomotive Cranes, 5 to 75 tons, Wrecking Cranes 75 to 200 tons, Freight Cranes, Transfer Tables, Rillsaws, Pile Drivers, Clamshell Buckets, Steam Pile Hammers.

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Pit and Quarry

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Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

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Vol. 14

CHICAGO, ILL., JUNE 22, 1927

No. 6

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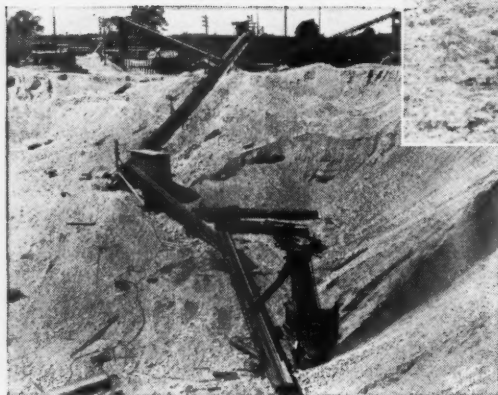
Cutting Costs on the Long Lift from Pit to Plant



This Barber-Greene Permanent Conveyor carries sand and gravel 235 feet from pit to plant. It is fed by a shorter B-G that can be moved around whenever conditions demand.



Two Barber-Greene Conveyors working in series carry away all the strippings that the shovel can dig.



An unusually flexible arrangement of Barber-Greene Portable and Permanent Conveyors. And notice the B-G Bucket Loader digging from the bank and feeding the conveyor. This system can be moved easily to follow the bank.

And the Warren Truss construction combines rigidity and strength with the exceptional light weight that makes for convenience.

In addition, Barber-Greenes work year after year without break-downs and without high operating or maintenance costs.

Why not send for complete information and detailed layouts of Barber-Greene installations? It may prove valuable to your cost and profit records. And it will put you under no obligation.

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Pit and Quarry

Vol. 14

CHICAGO, ILL., JUNE 22, 1927

No. 6

THE FIRST AND THE LATEST ISSUES OF PIT AND QUARRY



The first paper to be published exclusively for operators of pits and quarries. This maiden number contained 48 pages, 24 pages of reading matter and 24 pages of advertisements.

The above comparison brings to realization the remarkable growth of PIT AND QUARRY. During 1926, PIT AND QUARRY published more major articles on cement, lime, gypsum, stone, sand and gravel and devoted more space to them than did any other publication. And, to date, this year it leads.



The latest issue of PIT AND QUARRY contains 63 pages of reading matter and 73 pages of advertisements, a growth from 6x9 inches (trimmed) to 9x12 inches (trimmed), and from 48 pages to 136 pages in bulk and from 3,000 to 7,000 copies in circulation.

During 1926, the manufacturers of equipment for the non-metallic mineral industries patronized PIT AND QUARRY for advertising purposes to the total of 1,943½ pages, or at an average of 78 pages per issue.

TARDINESS AND ABSENTEEISM

THROUGHOUT American industry, workers are absent from their tasks an average of 21 days per year of 300 working days, according to the most reliable statistics available. This 7 per cent average absenteeism record imposes a heavy burden on the employers of the nation and upon the country's production. In addition to the loss through absenteeism is the larger, though incalculable, waste of tardiness. The time lost by workers in getting started at their jobs after the whistle blows constitutes, of itself, a great economic waste and one that is probably more serious than is commonly supposed.

There are many ways of reducing the costly operating elements of absenteeism and tardiness. These will vary with the institution, since in some plants the factors will be far more serious than in others. Where employees are engaged in group work, or on a piece work basis, tardiness is automatically reduced to a negligible factor. No industrial organization is entirely free from both, however, for the plant wherein tardiness has been minimized will doubtless show a higher absenteeism record.

Not infrequently, tardiness is caused more by mismanagement than by workers' indifference or laggardness. The mere re-location of time clocks has, in some cases, greatly reduced tardiness. Workers are wont to consider themselves on time if they "punch in" before or as the whistle blows—entirely overlooking the amount of time consumed in getting from the clock to work. The simple operation of a machinist punching a clock, then walking to a distant part of the plant to get to his machine, very likely stopping on the way to ex-

change greetings with a fellow worker or to get a drink, will, if continued over a period of months, mount to large and costly proportions in time and production value. Locating the time clocks so that they are as near as possible to the actual scene of operations will many times effect a material reduction in tardiness.

The old practice of "docking" or penalizing an employee for lost time is rapidly giving way to the more positive method of rewarding punctuality. In a great many plants a few years ago, and in some of today, the practice of penalizing a man a full quarter of an hour for every lost fraction thereof was employed. This rather negative measure for discouraging tardiness is now being discarded and the plan for paying bonuses, ranging from 2 to 10 per cent of the worker's earnings, is being substituted. In the majority of cases the positive method has been found to be far more resultful.

Instead of a straight monetary reward, some plants allow a day's vacation to every employee having a perfect record for attendance and punctuality during the month. In figuring these records consideration should be given to the promptness displayed in getting to work as well as the actual clock record. Sometimes it is advisable to arrange a sliding scale of reward to encourage 95 per cent, as well as 100 per cent, records. If the bonus periods are too long an employee who has, for some very good reason, failed to qualify for the bonus or day's vacation for a particular period will be inclined to disregard his attendance and punctuality record for the remaining portion of the period, feeling that he has nothing to lose.

TAKING BUSINESS AT OR BELOW NORMAL COST

CHARLES R. STEVENSON of Stevenson, Harrison and Jordan, management engineers, disclosed the results of a questionnaire on the economic effect of taking business at or below normal cost to the International Conference of the National Association of Cost Accountants on June 14. This questionnaire was answered by 8,000 manufacturers and consisted of eight questions. The results are interesting. Those who qualified their answers are not included in these percentages, but can be estimated as half and half of the remaining percentage in each question.

Do you believe that business should ever be taken at normal cost? Yes, 38 per cent; No, 42 per cent.

Do you believe that business should ever be taken below normal cost? Yes, 14 per cent; No, 72 per cent.

Do you believe that the theory of incurring losses by taking business at or below normal cost with

the idea of absorbing overhead is sound? Yes, 12 per cent; No, 72 per cent.

Do you believe that the financial loss incurred in keeping your organization intact by taking business at or below normal cost benefits you in the long run? Yes, 15 per cent; No, 69 per cent.

Do you believe that in the long run the gain from greater buying power sufficiently offsets the financial losses incurred by taking business at or below normal cost? Yes, 4 per cent; No, 87 per cent.

Do you believe that you can take business at or below normal cost without affecting adversely the industry of which you are a part? Yes, 6 per cent; No, 87 per cent.

Do you consider it fair to other concerns in the same industry to take business at or below normal cost? Yes, 9 per cent; No, 78 per cent.

Do you believe that any industry as a whole in its competition with other industries should ever take business at or below normal cost? Yes, 9 per cent; No, 72 per cent.

TECHNICAL CONTROL VALUE DEMONSTRATED BY TENNESSEE MINERAL PRODUCTS

WITH advancing civilization has come the demand for increasing refinements in requisites for cleanliness, sanitation and convenience, and the ceramic industry has met this demand with new or improved products. In these, feldspar is an indispensable ingredient. It is the flux which unites the other ingredients and which gives the necessary strength to the body and attractiveness to the glaze of fine pottery. Mineralogically it is one of the commonest of rock-forming minerals, but it is comparatively rare in a form of sufficient purity for commercial use. There are, however, vein or dike formations, known as pegmatite or giant granite, in which the minerals are all very coarsely crystallized, the individual crystals being measured in feet or yards rather than fractions of an inch. Feldspar occurring in this way may be separated by blasting and clobbering from the associated minerals.

Pegmatite dikes of this nature are scattered through all the mountainous regions of the country, but they occur principally in the Appalachians, where workable deposits of feldspar have been found from the southwestern extremity in Georgia to the various extensions through New England and Canada. Through all this area the general trend is to small groups or isolated deposits, but in Western North Carolina, in the counties of Mitchell, Avery and Yancey, constituting the Spruce Pine mining district, more feldspar has been found than in any

similar area. This section is also called MAYland, from the initials of the three counties composing it.

The Clinchfield railroad was completed through this district in 1907, and in 1911 the first carload of feldspar was shipped. From that time production increased rapidly and by 1917 North Carolina became the principal producing state. From the annexed table of statistics by the United States Geological Survey it appears that 1927 will probably show North Carolina producing over 50 per cent of the total output of the United States.



Picking Slips From Flat Cars For Conveying to Cableway Terminal Bin



View of Plant From Narrow Gauge Railroad Grade Across the River



Main Hoisting Level in Deer Park No. 4 Mine

Production of Feldspar in Tons

Year	North Carolina	Total for U. S.
1911	300*	84,000
1912	4,000*	76,000
1913	11,000*	107,000
1914	15,420	121,000
1915	20,635	101,000
1916	30,955	118,465
1917	42,463	126,715
1918	35,732	88,498
1919	22,495	63,441
1920	35,883	135,551
1921	40,172	91,865
1922	56,043	117,127
1923	57,622	145,004
1924	97,075	204,772
1925	76,806	185,706
1926	95,000*	200,000*

*Estimated.

This phenomenal growth of the feldspar industry in North Carolina is attributed to the following causes: First, the predominance of good outcrops in this area; second, the fact that a trunk line railroad runs through the heart of the feldspar district; third, the good highways connecting the deposits with the railroad; fourth, the large amount of money spent by the various corporations in developing the deposits.

North Carolina is now noted for its feldspar deposits and each year shows a definite advance in the state's production facilities to serve the ceramic industries. The whiteware and enamel branches of manufacture formerly were the largest consumers



Picking Belt Building and Crude Storage Bin

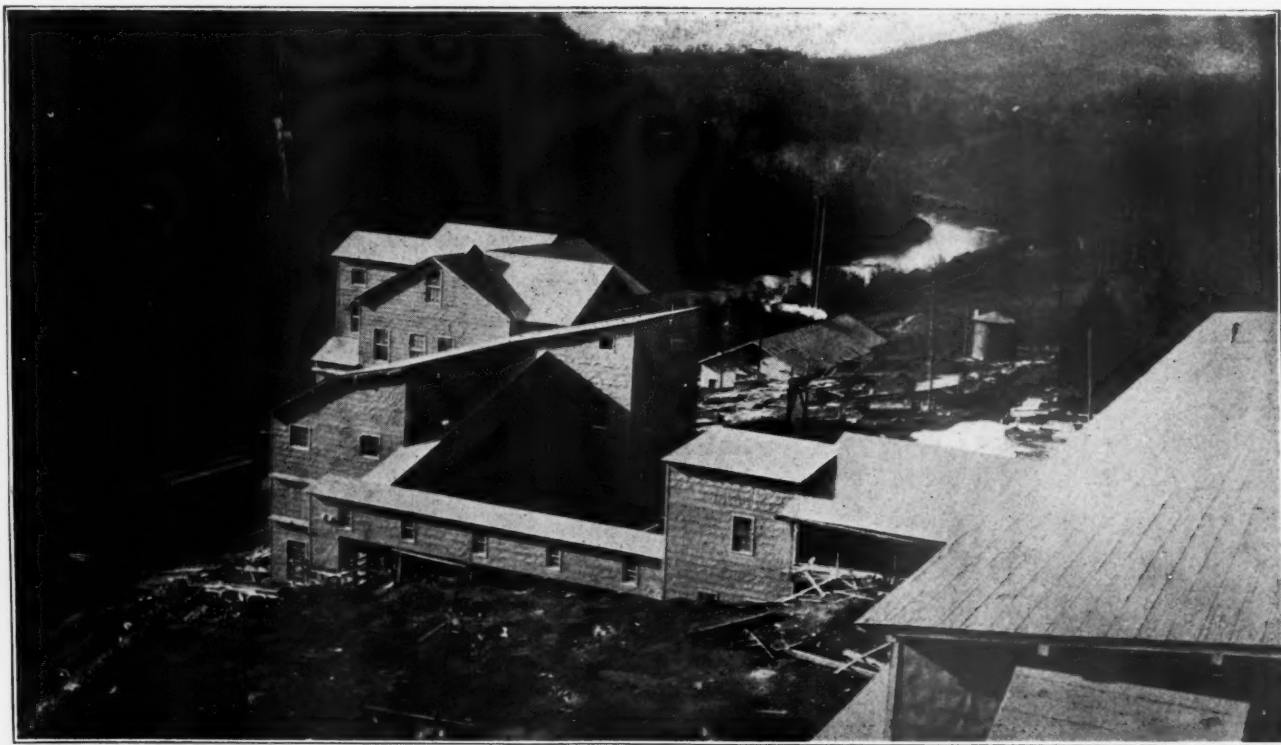
of feldspar from the district, but increasing quantities are now going into tile, sanitary ware, electrical porcelain, glass, abrasives, etc. The Spruce Pine feldspar district covers an area approximately 12 miles wide by 30 miles long. Though it has great resources, only a few very large deposits have been found. These are in the hands of well established concerns, and the market for the ground product is so well supplied by present producers that there is little incentive for new capital to enter the field.

Most of the known deposits vary greatly in both physical and chemical analyses. This applies not only to different mines, but even in single deposits it is common to find considerable variation within a short distance. Mica, quartz and other foreign minerals occur irregularly. Under these conditions production of a uniform finished product on a considerable scale is not easy, and for some years therefore the mining operations were carried on in a limited way. As a result North Carolina feldspar at first lacked uniformity, and suffered somewhat in reputation. The presence of foreign materials was also a handicap in meeting competition from fields where producers had had more experience. The improvements made in local production methods within the past few years have, however, gone far toward correcting the wrong impressions of the trade.

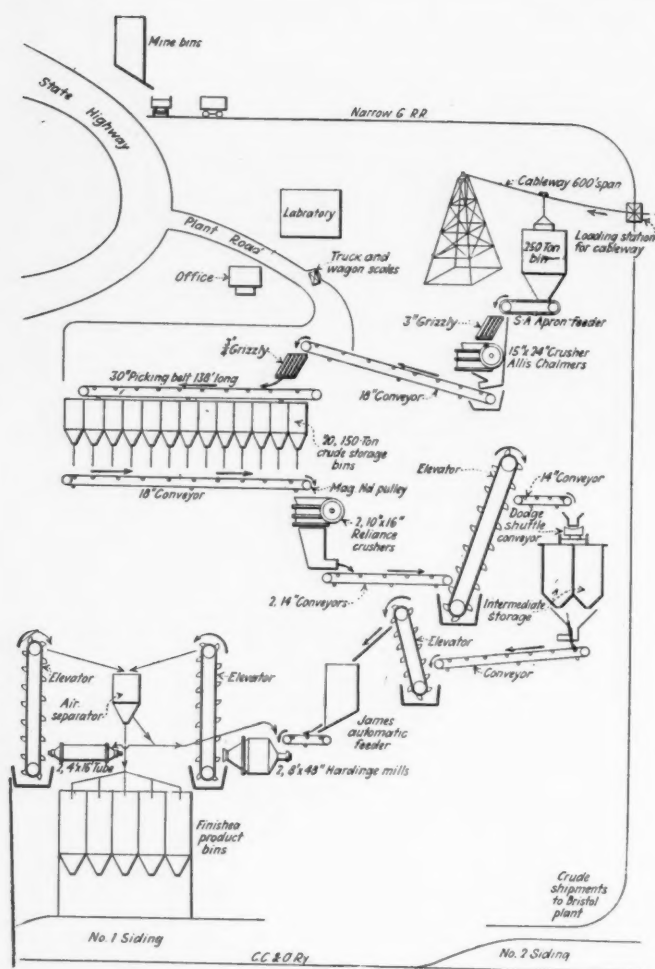
The Tennessee Mineral Products Company, with a plant established at Bristol, Virginia-Tennessee, five years ago, has had a large part in proving that uniformity is commercially obtainable from North Carolina feldspars. Based on the experience gained in that plant, their new plant at Spruce Pine, North Carolina, is so equipped and operated that uniformity can be assured for any of several grades of



Textrope Drive



Fine Grinding Plant From Top of Cableway Bin



Flow Sheet of Mill

ground feldspar. In fact, practically any analysis within the range of the raw material can be produced in any required quantity.

The company's property consists of an aggregate of 2,000 acres in the heart of the feldspar area. Six mines are now being operated, the largest of which is Dee Park, number 5, which is one of the

first deposits opened in 1911. A typical analysis of the product is as follows: SiO_2 , 67 per cent; Al_2O_3 , 18 per cent; K_2O , 12 per cent; Na_2O , 21½ per cent. The deposit is not fully developed, but present openings show a width of 80 to 100 feet, a length of 250 feet and a depth of 200 feet. The vein is a giant pegmatite, the crystals of feldspar, quartz and mica being several feet or yards across and segregated into groups. The separation of pure feldspar is partially accomplished in the mine by selective blasting and completed by hand on the picking belt at the mill. Of the other deposits being mined by the company one is a high-grade soda spar (albite) analyzing SiO_2 , 71 per cent; Al_2O_3 , 18 per cent; Na_2O , 8 per cent, and K_2O , 2 per cent. With these extremes of chemical composition and the facilities at the plant for segregating or combining them any desired commercial requirement may be met.

The new plant has many interesting features. The location is ideal, the mill site being on sloping ground, providing partial gravity flow, and it lies between the main highway and the main line of the Clinchfield railroad, directly across the river from the company's principal mining property. A narrow-gauge railway line has been installed between the mines and one of the main sidings near the plant. A gasoline locomotive is operated over this line, affording convenient and cheap haulage. At the junction the crude material is loaded into cars for shipment to the grinding mill of the company at Bristol; if destined for the new plant it is halted on the mine side of the river, elevated by a Flory suspension cableway and deposited in the 25 ton crude storage bin.

The flow of the material from the storage bin is in the following order. It is taken on a Stephens-Adamson apron feeder and fed onto a 3-inch grizzly, which removes the large pieces. Material

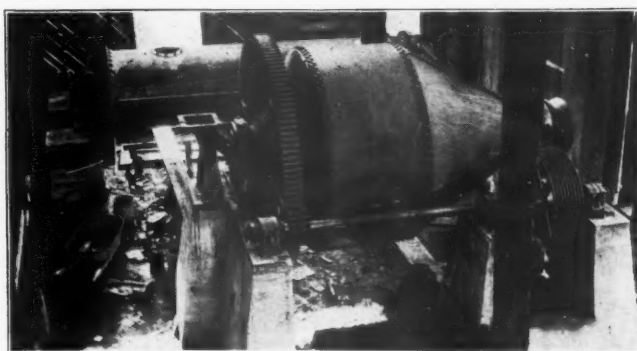


General View of Plant From One of the Mines Across the River

which falls through the grizzly drops into a 15 by 24 inch Allis-Chalmers jaw crusher. After passing through the crusher the material is carried by an 18-inch elevating conveyor to a $\frac{3}{4}$ -inch stationary bar grizzly. The feldspar which passes through the grizzly drops on to a 30-inch picking belt, 138 feet long, where material which is not suitable is removed. This belt travels over storage bins, with a capacity of 3,800 tons in which the material is deposited.

From these bins the material is carried by an 18-inch conveyor to two 10 by 16 inch Reliance crushers. The conveyor is provided with a magnetic pulley which removes all metallic substances as the feldspar passes over the pulley. After passing through the secondary crushers the material falls on two 14-inch conveyors which feed it to an automatic sampler. From here the feldspar is fed into an elevator which drops the material from its buckets on a conveyor which transfers it to mixing bins, which have a capacity of 1,000 tons. From these bins the material is carried either by elevator or conveyor to the surge bins, screens, two 8 feet by 48-inch silex-lined Hardinge pebble mills, two 4 by 16 feet silex-lined tube mills and an air separator. The product is finally taken by elevators to the finished product bins at the railroad siding.

A distinct innovation in feldspar production is the automatic sampler and mixing bins used at this plant. These enable the company to sample the material accurately and, following, to place it in separate storage bins, each of which has a capacity of 50 tons. Thus a customer placing an order for one or more carloads of feldspar can secure mate-

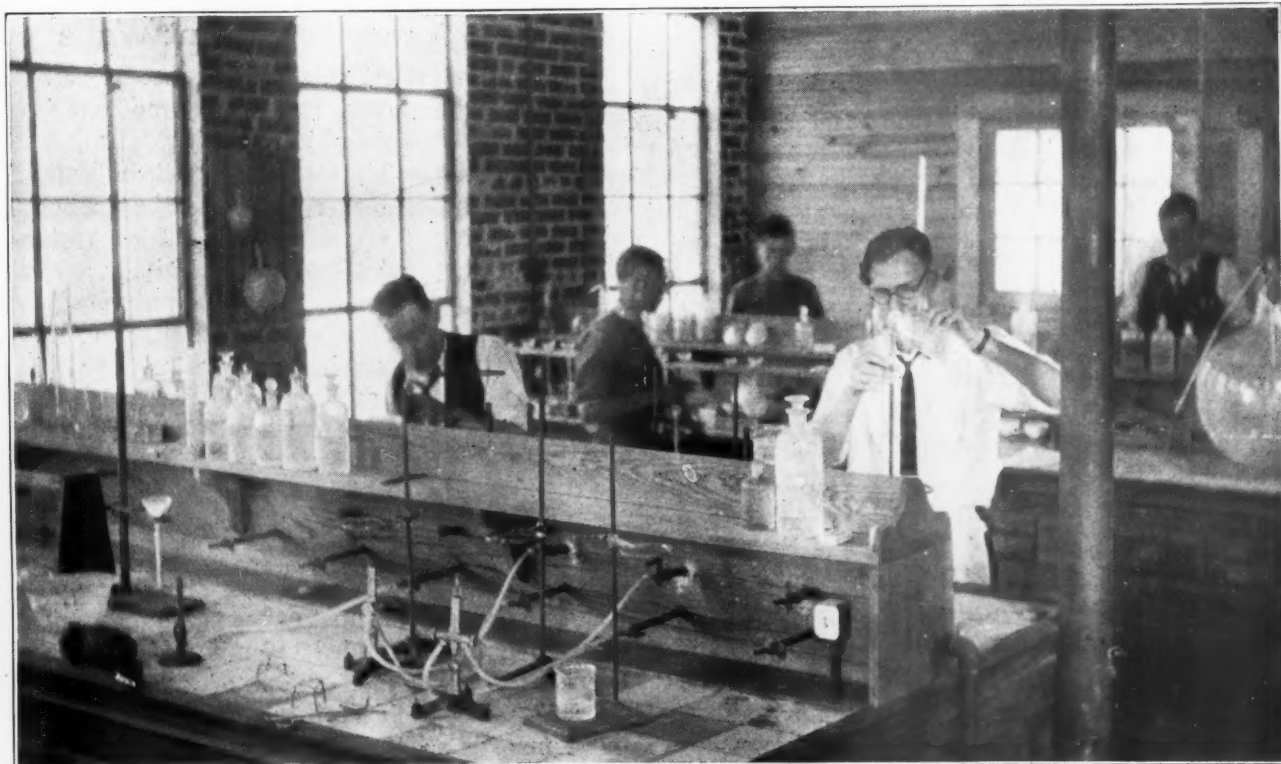


View in Fine Grinding Plant

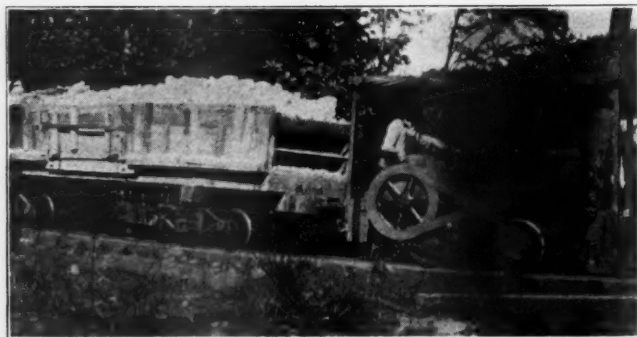
rial to his particular specifications. The operator, to carry this out, draws from one or several of the bins such proportional amounts as called for by the chemist preparing the order. The contents of each bin will vary from that of the others, thus affording ample opportunity for selection.

Appreciating the value of this technical control of the material, as determined by analysis, the company have developed this system to a definite standard, featuring an analysis and screen test with each car shipped in all cases where such is desired. A modern fire-proof laboratory, 40 by 40 feet, has been erected to meet the requirements of this branch of operation and to provide every needed facility to carry out the work.

The power equipment at this plant consists of an engine-generator unit of Skinner uniflow type, with rated output of 300 h.p. and sufficient for 30 per cent overload with safety, which fully meets the requirements. Directly opposite the power plant is the coal storage, and a siding, recently installed,



A Corner of the Laboratory



Load of Material in Transit

provides a trestle for service to this point. The plant has also a track scale of large weighing capacity, as well as other facilities.

The Tennessee Mineral Products Company maintains its eastern headquarters at Beverly Farms, Massachusetts, and local offices at each plant. Frank P. Knight is president of the company and associated with him as directors are Frederick J. Merrill, Nathan A. Taylor, Frank A. Woodward, and Roland H. Knight. The operating officials are: B. C. Burgess, agent and general manager; L. F. Pearce, Minpro plant manager; Frank P. Knight, Jr., chief chemist and manager of the Bristol plant, and Sam Knight, chief engineer. The selling agents of the company are Roessler & Hasslacher Chemical Company, with headquarters at 709 Sixth avenue, New York City, and branch offices in all the large cities and ceramic centers of the country.

Lifting the Level of Efficiency

Efficiency contests, instituted to the end of increased production, are not new. The fact that they have been widely used for more than 20 years would seem to indicate the merit of the plan.

In arranging such a contest six points should be included, i.e.: workmanship, economy, veracity, good housekeeping, punctuality and attendance, general deportment. In explanation of these points, the details to be considered are:

1—Workmanship. All products, finished or in process, should be above criticism. Establish a standard of quality, then strive for its maintenance. Of the 100 points set up to cover the six divisions, 30 are allowable for performance of workmanship.

2—Economy. This point should also be included and made to extend to waste elimination of material, operation, labor and expenses. Fifteen points are allowed for accomplishments in this division.

3—Veracity. Honesty of purpose and the ability to keep promises are essential to success anywhere. This point should have a place in every efficiency contest since it affects everyone. Twenty-five points.

4—Good housekeeping. Tidiness has a direct bearing on production, morale and workmanship. Delays that result from untidiness would throw

into jeopardy ability to keep promises, hence the importance of this point. Ten points.

5—Punctuality. Tardiness or absenteeism militate against plant efficiency as do few other factors. The cost of idle machinery extends far beyond mere loss of production. Ten points.

6—General deportment. While good morale in any plant is dependent upon many factors such as working conditions, wage scale, management policies, etc., it directly reflects good foremanship. In this division 10 points are allowed.

Setting up a schedule of standards for such a contest will in itself be of benefit to both management and supervising personnel. Seeking the maintenance of those standards is a most healthy activity. A committee of three should be appointed to act as judges, and the awards (non-financial in character) made periodically: monthly, quarterly, semi-annually or yearly. The possession of a silver cup by particular departments is the usual monthly award, while a bronze tablet bearing the name of the department and that of the foreman or superintendent can be awarded for the highest standing on yearly periods.

Awarding the efficiency cup each month—the taking of it from one department to another in accordance with the judges' decision—can be, and doubtless will, become quite a ceremony. Naturally there is elation on the part of the winners, and determination on the part of the losers to "get it back next month."

Properly handled and supplemented by active, continuous publicity, an efficiency contest can become endless in length and almost limitless in beneficial effect.

Facing Stone or Cement Walls

The surfaces of stone, cement, concrete or brick walls are impregnated and waterproofed with a cementitious film applied by spraying thereon a dry powder which sets hydraulically, such as Portland or magnesium cement or lime, either alone or mixed with silica or brick-dust. The powder is applied by a current of compressed air or gas, and the surface is damp or in a damp atmosphere. Water, steam, or a solution of sodium silicate may be sprayed on the surface before or after the application of the powder, and new cement work may be sprayed with the dry powder before it has set. J. W. Dougal (British Patent 268,016).

Highway Program of Ontario for 1927 Will Cost \$6,000,000

The plans adopted up to the middle of May for Ontario, Canada, included 119 miles of 1-1½-3 mix concrete pavement; 57 miles of asphaltic black base; 27 miles of bituminous penetration, water-bound macadam; and 166 miles of surface treatment on existing macadam and penetration roads.

MILLIONS FOR COST REDUCTION

By B. F. Affleck

President, Universal Portland Cement Company*

INVESTING several million dollars in plant improvements, not to increase our producing capacity but simply in order to cut operating costs, is one answer we have made to the present condition of over-production, low prices, and high labor costs in the cement industry. That producing capacity today exists in excess of consumption in many fields is a fact that stands out conspicuously. In the portland cement industry, with which I am most familiar, after a period of good demand, we find the graph of sales has leveled off. For example, in common with most other companies in this field, we sold only slightly more cement in 1926 than we did in 1925. Yet producing capacity in the industry has kept right on growing. With cement mills selling their production during the last few years at a price which yielded a profit, newcomers hurried to enter the field. More and more mills were built and capacities of existing plants were increased. As a result the total consumption last year, while a little more than in 1925, was considerably less in relation to producing capacity. Today we find more mills in operation than then, increased production in existing mills, and more mills still being built. With this excess production prices naturally tended to fall, until at the time this article is written they are at relatively low levels. Labor costs, on the other hand, are high. Far-sighted manufacturers do not want to reduce purchasing power by cutting wages. Labor feels the same way.

Thus with cement prices low and wages high, with producing capacity not simply more than the average but considerably in excess of the greatest demand for cement the country has ever experienced, and with the product standardized so that all mills in this country manufacture to meet the standard specifications adopted by the United States Government, the American Society for Testing Materials, and other leading engineering societies, thereby eliminating any valid sales argument based on the superiority of one brand over another—with these conditions to face, we believe our most important problem is one of reducing manufacturing costs. That this is correct is indicated by our experience last year when, with shipments of cement somewhat greater than those of 1925, we earned less profit than we did in 1925 because prices were so low. At prevailing prices, the only means to insure a reasonable profit, as we see it, is to cut operating costs, and this is what we have done.

Investing several million dollars in our plants without increasing capacity by a single barrel has

so reduced manufacturing expense that the improvements will pay for themselves in a reasonable time. Included in this program is a \$2,000,000 harbor project at our Chicago plant that is now in operation. Take this harbor and dock development. We are not building it because we shall get any proprietary satisfaction from seeing impressive boats tie up at our private dock. We are constructing it because it will help reduce costs in two important ways. It will permit us to ship cement economically by boat and it will enable us to bring in bulky raw materials and feed them into our plant at a distinct saving over the cost of bringing the same materials in by rail. Where we have been shipping cement exclusively by rail, we shall be able now to use both rail and water. Where we have been getting part of our stone by rail, we shall now get all of it by boat from the quarry at Calcite, Michigan, the largest quarry in the world. The large-scale quarrying operations permit getting the stone out at low cost; the water haul results in a considerable saving in freight.

The deepest harbor on the Great Lakes, the largest boat on the lakes, one of the heaviest boat-unloading bridges in the Chicago district, a 55-acre harbor basin, a 30-acre storage yard holding a million tons of limestone or coal, a belt conveyor nearly a mile long, and a lighthouse with one of the brightest beacons on Lake Michigan are things we have had to supply in order to take full advantage of the economies inherent in our waterway program.

Most of the stone will come in self-unloading vessels which are equipped with elevators to bring the material up out of the holds and load it onto belt conveyors to carry it into the new storage yard. One of these boats alone can carry about 15,000 tons and can unload itself at about the rate of a ton a second.

As some stone will come by standard steamers other than self-unloaders, we have provided a boat-unloading bucket bridge of unusual size and weight. Being movable to any point on the dock and having a 10-ton clamshell bucket, it can pick up its generous bite of stone from any boat at the dock or from any point in the storage yard and deposit it on conveyors for speedy transportation to the plant.

Just as the \$2,000,000 spent on the harbor project will reduce manufacturing expense in the raw material end, so will another million dollars that we expended in our finishing mills lower operating expense there. Improved types of mills have been installed that will more efficiently grind clinker, the diamond-hard product resulting from

*Reprinted from *Factory* for May, 1927.

the burning process. While none of this million dollars will go toward increasing our production, the manufacturing economies secured will pay for the improvement within a reasonable time.

Besides changes in grinding and other equipment, we have further cut down maintenance costs by gradually shifting over our mechanical power transmission. This substitution of new transmissions enclosed in housings for the old open types is especially advantageous in a cement plant where dust and grit cause heavy wear on exposed machinery parts. Despite the most modern and effective means of eliminating dust that we employ, the air in the plant contains some extremely fine dust. At its softest, it is powdered limestone and coal; at its hardest, it is cement dust about eight in the scale of hardness where diamond represents 10. By installation of protected mechanical transmissions running in grease, we have substantially reduced the wear and tear on heavy, expensive machinery. Safety, too, is served by this change.

Following the same policy, we have also been shifting over from open belt conveyors to screw conveyors protected by housings. While the power cost of moving material by screw conveyors is somewhat higher, and while the wear and tear on the conveying equipment from grit is greater, the enclosed conveyors eliminate dust that formerly arose from open belt loads of the finely ground material. The saving this produces on other equipment through reduction of atmospheric dust in the plant has made the change worth while.

Saving \$25,000 worth of cement a year at one plant alone through dust collectors, in addition to protecting valuable machinery from damage, is another way we have cut manufacturing costs. Just as covered conveyors reduce loss from dust and lower operating costs, so installation of dust collectors throughout our plants has cut down damage to equipment.

The finished cement is extremely fine—finer, indeed, than flour or talcum powder. There is bound to be a great deal of it escaping into the air in the packing room. But by efficient dust-collecting installations we not only reduce damage to machinery from this source but we secure substantial savings in the fine material that is thus conserved. The dust never gets more than a foot or two away from its origin before it is sucked into a pipe and collected. In addition to the financial benefits, the removal of this cement dust from the air in the plant results in a decided improvement in working conditions.

Spending more than \$75,000 for an improvement which did not increase producing capacity a barrel, but which did cut costs of operation, describes our work in lowering the pitch of 12 large kilns. The change reduced consumption of fuel to such an extent that the improvement eventually will pay for itself.

Increasing the cost of grinding coal in order to obtain a lower fuel cost per barrel of cement at our Pittsburgh plant was another instance where spending money saves money, for through this change we save over 20,000 tons of coal per year at this one plant. To accomplish this result we had to throw out all our old coal-grinding equipment. To persons unfamiliar with cement manufacture, it may be explained that to produce the peculiar cementing qualities that make portland cement the strongest binder in commercial use, it is necessary to burn the finely pulverized raw materials in huge rotary kilns where the heat of 2700 degrees Fahrenheit—greater than that required to melt steel—almost fuses the materials, changes them into new chemical compounds, and produces clinker—lumps about the size of walnuts. Longer than a residence lot and large enough to drive a flivver through, these kilns are the largest pieces of revolving machinery in modern industry. With its load of material, a single kiln may weigh over a million pounds. Into these large kilns, pulverized coal, blown at the rate of a mile a minute, ignites and develops the intense heat required for burning. By junking our old coal-grinding machinery and installing new grinders capable of pulverizing the coal more finely, we increased the cost of grinding but reduced coal consumption per barrel of cement appreciably. On an average year's production this saves over 20,000 tons of fuel at this one plant.

Expending thousands of dollars to expedite handling in our sack department is another investment that did not increase capacity but that did lower costs. Cement sacks are leased by the cement purchaser and taken back by the manufacturer when returned in usable condition and the leasing charge refunded. Millions of used sacks are returned each year for credit. Handling them, sorting, cleaning, and repairing them so that they can be used again is a very considerable operation with us as it is with every cement manufacturer. Expediting this operation by literally putting our sack department on wheels involved a large expenditure but one that will more than pay for itself in a few years in time and labor saved. No longer are sacks dumped on the floor between processes. Returned sacks are unloaded from cars onto platform trucks, wheeled to cleaning rooms, then wheeled to the sorting operation, then by truck again to repair departments, to tying rooms where they are tied before being filled, and on to the sack storage. Hundreds of new platform trucks and other equipment representing an expenditure of many thousands of dollars were required for this change, but the convenience, time saved, and reduced operating expense secured make it a profitable investment in the long run.

While cement is handled by conveyors from the packing machines to a point near the car to be

loaded, it still is necessary to truck it by hand from this point into the car itself. Increasing by 10% the efficiency of this hand-trucking followed the development by one of our own employees of a special rocker-bottomed truck. The old-style, two-wheeled hand truck made it necessary for the trucker to wriggle the truck from under the sacks when he had them at the proper place in the car. The tier of sacks frequently got out of plumb and had to be tiered again by hand. With the new development, the trucker simply lifts the upper end and the truck tilts forward on the rocker, slides out from under the load, and leaves the seven or eight sacks of cement neatly stacked and firmly placed against the rest of the load in the car. This of itself seems like a small improvement, but when one realizes that last year we shipped over 60 million sacks of cement, its importance in cost reduction is appreciated.

Then there is the new stockhouse just completed at our Pittsburgh plant—the largest single-unit cement storage bins in the country. It cost us well over half a million dollars, but the advantages it produces make it a paying investment. It enables us to handle cement more rapidly and more economically and it provides cement storage space for about two million sacks of cement. This more nearly allows continuous plant operation in off-construction seasons when shipments drop, and as a result it reduces shut-downs and cuts overhead.

It would be possible to describe many other recent improvements we have made to reduce production costs, but mere mention of them will suffice. Waste-heat installations which conserve waste hot gases and utilize them in generating part of the power consumed by the plant; dust collectors on kiln stacks which catch over a quarter of a million tons of raw material a year, thereby effecting an important saving in material and preventing it from being blown over the surrounding district; a subway under three railroads at the Chicago plant saves time and averts danger from grade crossings—these are but a few of other developments.

But enough has been said to indicate our policy of investing millions of dollars in plant improvements in order to cut manufacturing costs and permit us to meet a constantly increasing competition.

The expenditure of millions of dollars in order to reduce operating costs seems to us to be the logical answer to present conditions in the cement industry. With producing capacity much greater than consumption, a cement manufacturer cannot expect profit from planning still greater production. With present low prices of cement, he cannot expect to operate profitably by making them still lower. One thing left is to reduce manufacturing costs and this is what we are doing.

Take Ten Percent of Your Fuel Bill for Instruments

Contrary to popular belief, and in the face of mechanical development of the past ten years, the average boiler plant is not equipped, in the matter of recording devices and instruments, in a way that will permit the greatest possible efficiency. An astonishingly large percentage of industrial boilers have no stokers but are shovel fired. Many plants have practically no instruments.

This is regrettable and leads to the belief that the increased power production at decreased fuel consumption noted during recent years has been brought about only through the larger, more extensive, and recently built plants.

Boiler room instruments are an absolute necessity to economical power production. There can be little or no assurance that the fuel is giving its highest energy or that the power generated is being successfully transmitted without automatic or semi-automatic instruments. If the boiler room in your plant is not equipped with instruments that make possible higher efficiency, then a definite, annual appropriation of 10 per cent of the yearly fuel bill should be set aside and used for the purchase of such instruments as are advisable under your individual conditions. With a fuel expense of \$5,000 a year this would mean an annual expenditure of \$500—to be continued until such time as the plant was properly equipped.

One of the most needed instruments, and one which unfortunately is conspicuous for its absence, is the steam flow meter. Steam flow meters are almost indispensable for the plant where it is necessary to continuously check the various uses for which steam is generated and apportion properly the costs for the different departments using the steam. Properly installed flow-meters will total the quantity of steam used in the engine room; they will total the quantity of steam used by each unit;—quantity of steam used by each department; the total quantity of steam used for all manufacturing processes. Used in connection with other data they will determine the pounds of steam generated per pound of coal consumed, and the total cost of generating that steam.

By simple comparison, steam flow meters will show you which boiler is lagging behind and therefore must be in need of repair or cleaning. They will discover wastage of steam and afford a line on feedwater regulation in the interest of best results. Other boiler plant instruments make possible equally definite assurance of performance on other angles of power production. Proper analysis of conditions will indicate what instruments should be installed on the 10 per cent budget set up. Ordinarily the money invested in boiler plant instruments pays dividends ranging from 20 to 33 per cent.

VICE-PRESIDENT CHARLES G. DAWES FORMALLY OPENS PRIVATE HARBOR FOR UNIVERSAL PORTLAND

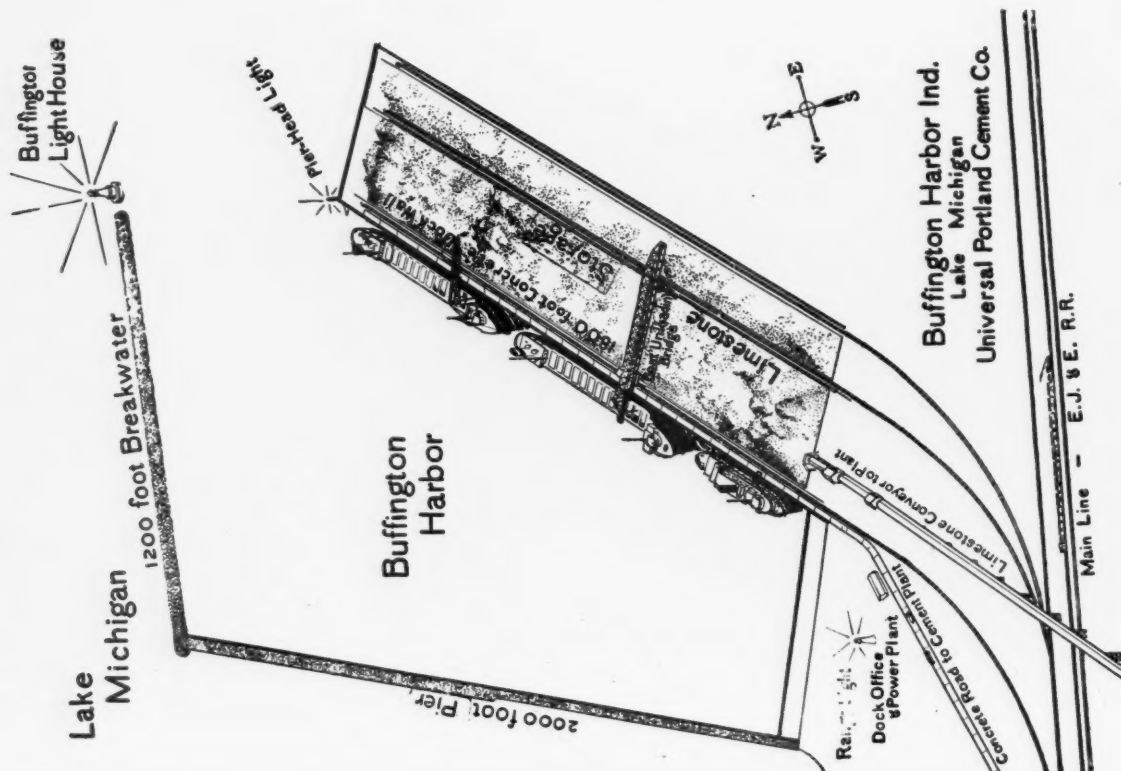
INAUGURATING a new transportation era in the construction and building material industry, Vice-President Charles G. Dawes, on June 9, formally opened to navigation the new Buffington, Indiana, Harbor, the deepest harbor on the Great Lakes, the first private harbor to be built on Lake Michigan in 20 years and one of only three such harbors on all the Great Lakes, the others being at Gary, Indiana, and at Calcite, Michigan.

Three thousand persons, including nationally known architects, engineers, contractors, public officials and civic leaders, attended the opening as guests of B. F. Affleck, president of the Universal Portland Cement Company, which built and owns the harbor. In addition to Vice-President Dawes, other prominent men who participated were U. S. Senator James E. Watson of Indiana, Congressman E. W. Sproul of Illinois, Mayor R. P. Hale of East Chicago, E. J. Buffington, president of the Illinois Steel Company, for whom the harbor was named, and T. W. Robinson, vice-president of that company; B. F. Affleck and Blaine S. Smith, president and vice-president of the Universal Portland Cement Company; A. F. Harvey, president of the Pittsburgh Steamship Company; Carl D. Bradley, president of the Bradley Transportation Company and the Michigan Limestone and Chemical Company, and A. F. Banks, president of the Elgin, Joliet and Eastern Railroad.

A feature of the event was the presence of two large freighters, the "T. W. Robinson," a self-unloading vessel, and the "Eugene J. Buffington," a standard steamer, each carrying 12,000 tons of Michigan limestone which was unloaded during the ceremonies.

This substantial waterway improvement includes use of the largest fleet of freighters on the Great Lakes, with self-unloading craft that automatically discharge their huge cargoes at a ton a second, the largest movable boat-unloading bridge in the Chicago district for unloading standard steamers, a million-ton storage yard, a mile-long belt conveyor carrying material from dock to cement plant at the rate of six tons per minute, an 1800-foot concrete dock wall, 600 feet wide, that provides facilities at the same time for unloading limestone and loading cement for shipment, a 2,000-foot massive breakwater and an all-concrete lighthouse with an electric beacon visible 13 miles away.

The opening of Buffington Harbor inaugurates a new transportation era in the construction field and improves and enlarges service to users of building materials, as it enables the Universal Company to receive by boat and store large quantities of raw materials and to ship cement by both rail and water to all points on the Great Lakes and in the Mississippi Valley.

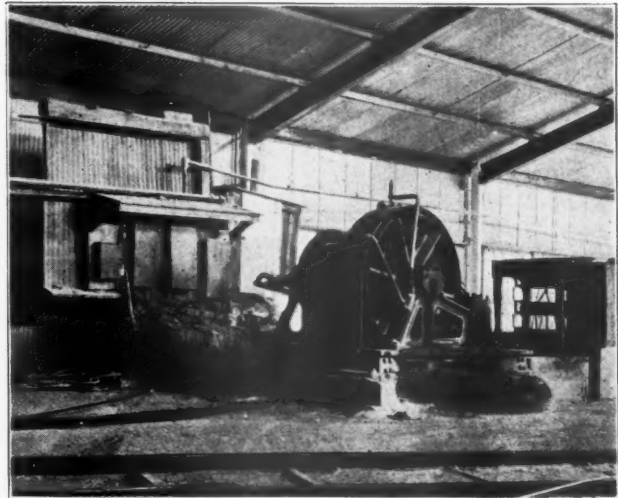


LEE LIME CORPORATION HANDLES LIME WITH NOTEWORTHY ECONOMY

By F. A. Westbrook

REDUCING the number of men required to handle the output of ten kilns from 43 men to 4 by the installation of mechanical drawing equipment is the achievement of the Lee Lime Corporation of Lee, Massachusetts. Handling the production of 200 tons per day with only four men is well worth an article. This machinery was installed at a time of high prices and when profits were good. In other words this company made itself ready at a time of prosperity to cope with more difficult conditions which might follow.

The lime producing plant consists of ten coal burning kilns operated by forced draft. Each of these kilns is provided with a Caldwell (now owned by Link-Belt Company) drawing conveyor which is located on the drawing floor. Each conveyor is driven by its own 3 h.p. individual induction motor so that they may be operated independently. Under the discharging ends of the conveyors is a track



Hoist For Pulling Cars to Top of Cooling Bins

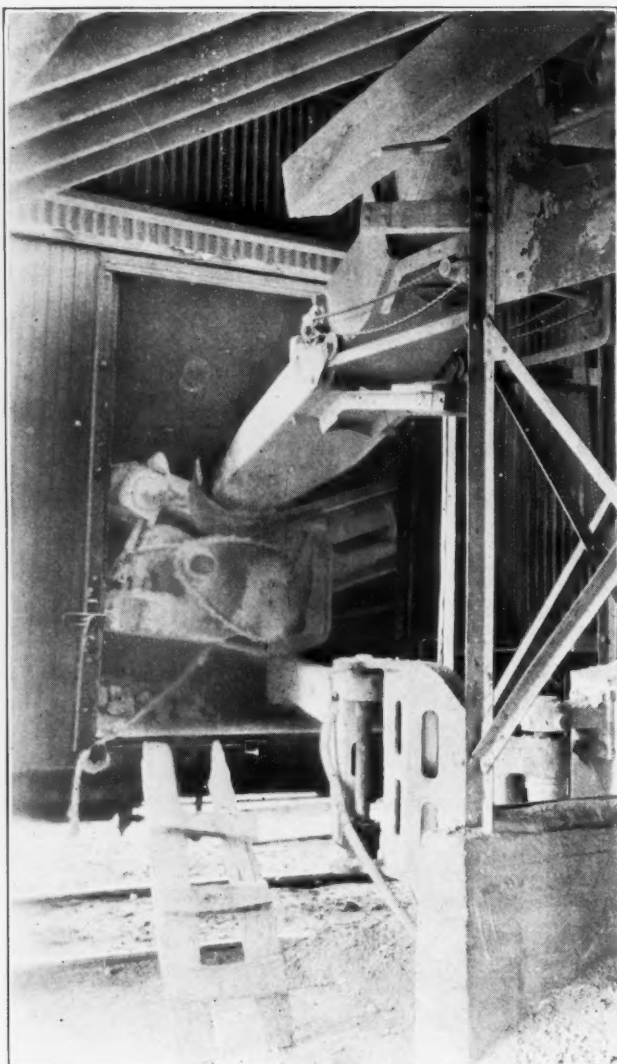
over which 5 ton Link-Belt dump cars may be run to receive the burned lime. The cars are pulled by



Breast of Quarry Showing Tracks



Incline to Top of Cooling Bins



Freight Car Loading Conveyor



Conveyor to Freight Car Loader. Vibrating Screen Is Shown at Right

a small electrically driven hoist, specially installed for this purpose.

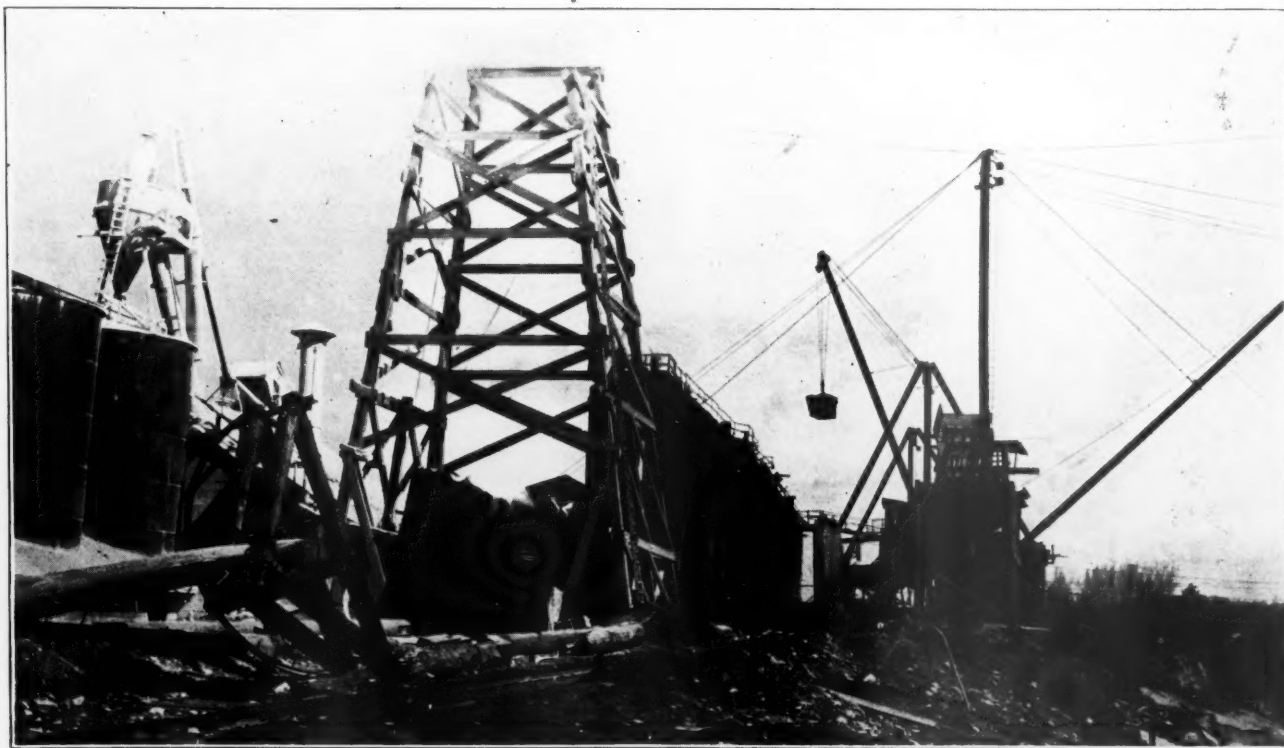
After being loaded the cars are switched on to another track and are weighed on a Fairbanks scale. They are then hauled up an incline over hoppers, or cooling bins, into which the lime is dumped. A Flory hoist with a 50 h.p. General Electric induction motor is used to haul the cars up the incline. A conveyor under the cooling bins carries the lime into a hopper and from this it passes over a shaking screen. The fine material passes through the screen and drops to a belt conveyor which carries it to the hydrating plant. The large pieces of lime slip over the top of the screen and drop on another conveyor which carries them direct to a bulk freight-car loader. A man is stationed on each side of the conveyor leading to the car loader and breaks up the large pieces, picking out any inferior grade. All this equipment is of Link-Belt manufacture.

At the present time all shipments are made in bulk but there are side openings at the bottom of the cooling bins from which lime may be taken for barreling if necessary. The kiln house is so situated that a spur from the railroad, the Berkshire Division of the New Haven Railroad, which passes very close to the plant, has been constructed on the loading side alongside the building. Freight cars are handled on this spur by a Vulcan shift engine and the freight cars are weighed on a Bennington suspended scale. The kiln house is constructed with Wheeling corrugated galvanized sheathing on the roof and sides.

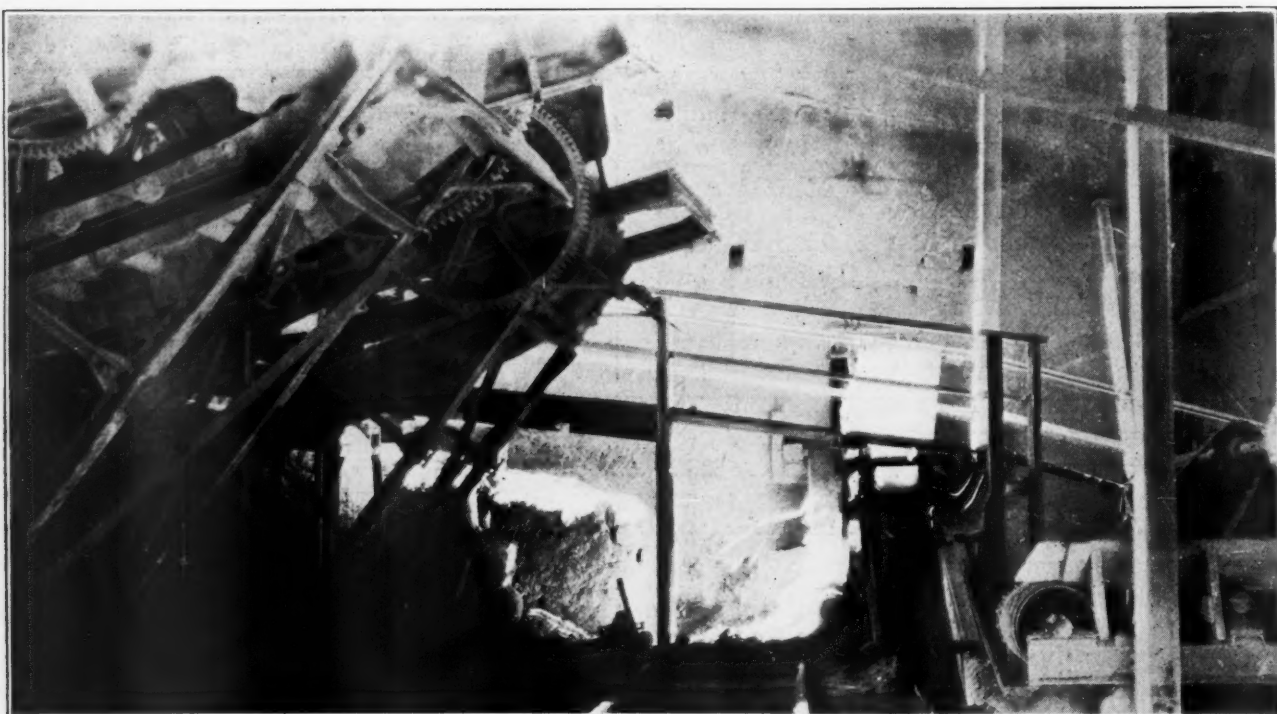
The hydrating plant is located in a separate building and the conveyor from the shaking screen, in



Bagger in Hydrating Plant



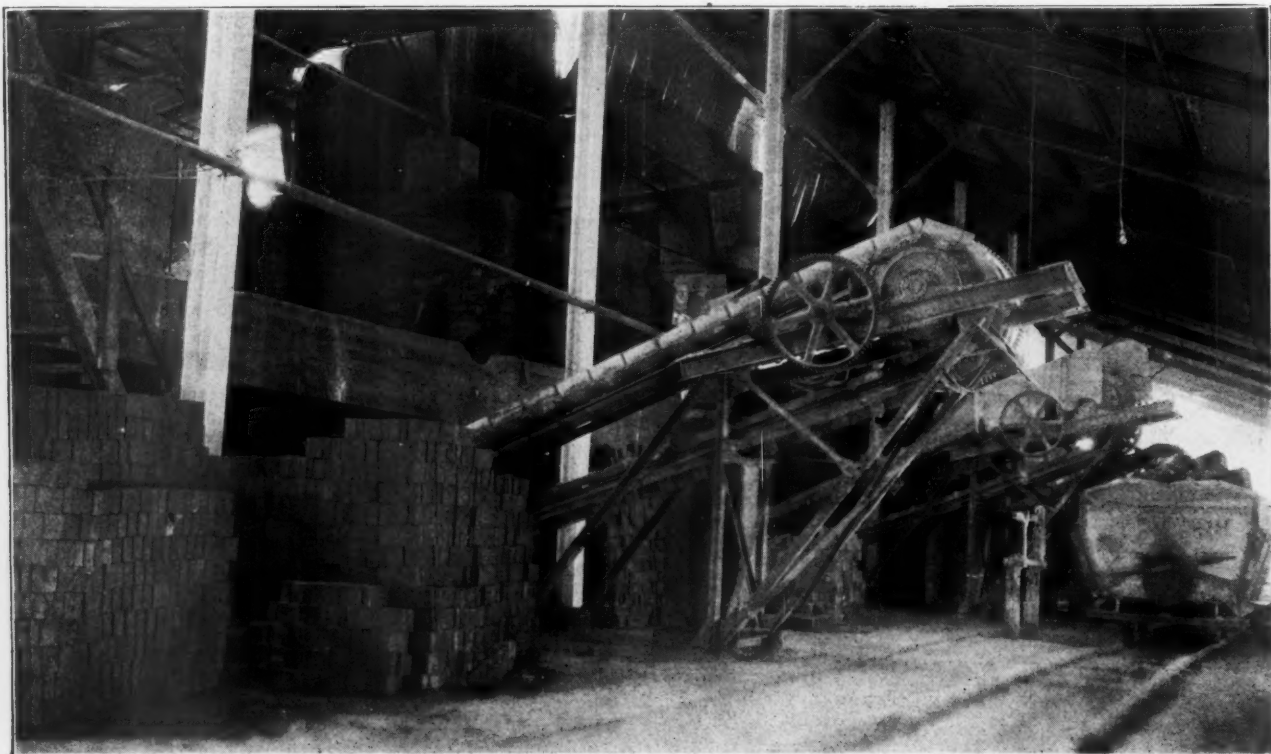
Kilns Being Charged With Stone by Derricks Raising Material Direct From Quarry



Conveyor to Hydrating Plant in Right Center

the kiln house, delivers the lime to a Sturtevant crusher and grinder in the hydrator house. From the grinder the lime is elevated to the storage bins from which it is fed into a Kritzer hydrator. It is then reground in a Raymond mill and passing through the air separating system is deposited in storage tanks. A conveyor carries the hydrated lime from these bins to the tanks over the Bates bagger which is also so placed that the bagged hydrated lime may be loaded directly on to freight cars on the company's siding.

The plant is located advantageously on the edge of the quarry and the most has been made of the opportunity so presented of charging the kilns with a minimum of manual labor. The procedure is as follows: The stone is picked over by hand at the breast of the quarry and is then placed in boxes set on platform cars. These are then hauled by a 4-ton Plymouth gasoline locomotive to the side of the quarry, adjacent to the plant. At the top of the quarry are three derricks which move the material to the top of the ten kilns; the loaded box is simply



Drawing Conveyors Under Kilns

lifted off the platform car in the bottom of the quarry, raised by a derrick and dumped into a kiln.

A well drill is used for preparing for the big shots. Three Sullivan jack hammers capable of drilling holes 30 feet in depth and an Ingersoll-Rand jack hammer are also in service. For blasting, 40 to 50 per cent Du Pont dynamite is employed for the main shots and 20 per cent for the top.

The Connecticut Lime Company at Canaan, Connecticut, and the Tobey Lime Company at West Stockbridge, Massachusetts, are under the same ownership as the Lee Lime Corporation, and the operations of the two former companies have been previously described in *Pit and Quarry*. To give an idea of the importance of some of the building jobs serviced by the Lee Lime Corporation and their wide geographical distribution, the following examples are given: The new Presbyterian Hospital in New York City, the Albee Theater in Brooklyn, N. Y., the new building of the Travelers Insurance Company at Hartford, Conn., Narragansett Electric Light Company Building, Providence, R. I., and the Beacon Trust Building, Boston.

Saving Through Salvage Systems

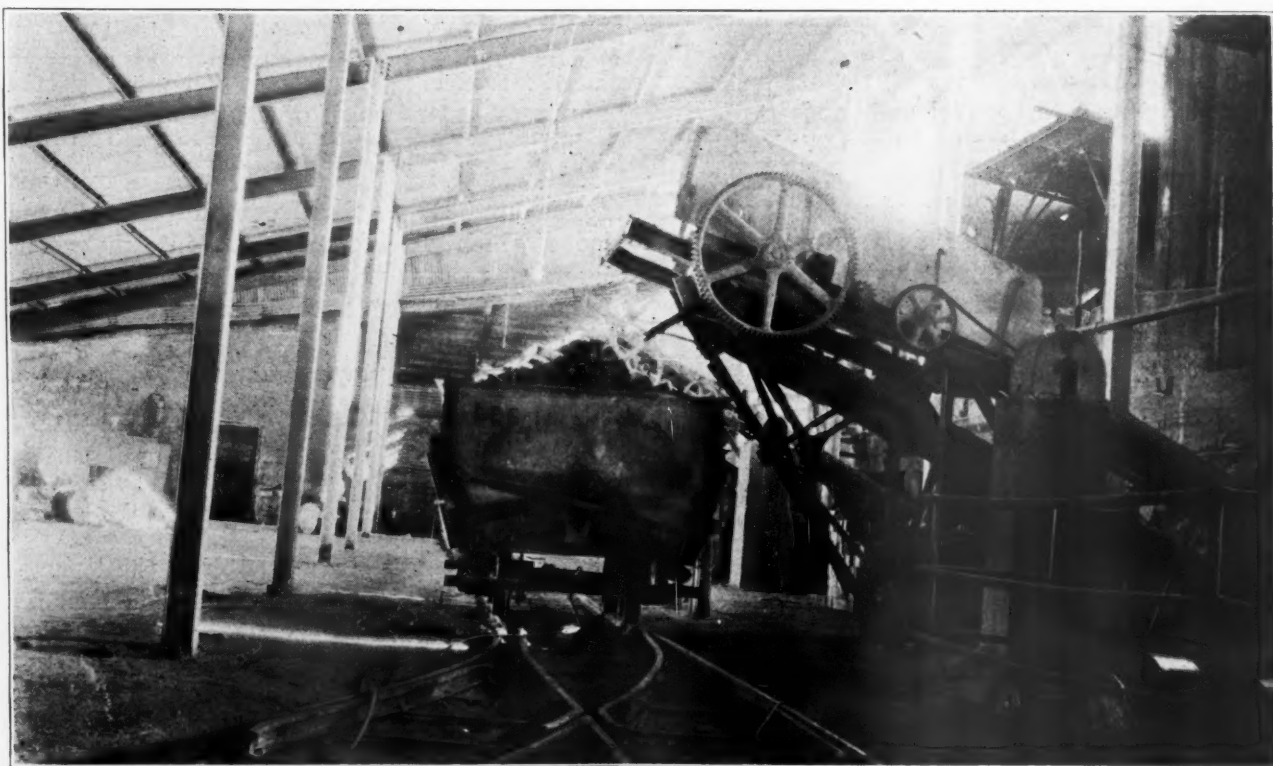
Invariably a simple, efficient salvage system will yield an economic return all out of proportion to its cost. In nearly every plant there are countless possibilities for salvaging materials. As an example, floor sweepings will usually yield such items as bolts, nuts, screws and other material, depending

on the nature of the work, which may profitably be reclaimed and returned to service.

Wood and lumber products are usually present in nearly every plant. In one fairly large company two employees were detailed to make the rounds of the plant daily and collect all materials of this kind. This was brought to the wood shop, wherein was installed a power saw. Nails and fasteners being removed, this material was cut into sizes that would conform to the plant's standards. From it new crates and packing cases were made, the scrap going into tote boxes, etc., the sawdust being saved for use on floors, then later burned as fuel under the boilers. As an instance of the value of such effort, one large automobile manufacturer annually salvages over 80,000,000 feet of lumber in this manner.

Formerly the price of rags was so low as to permit the discard of used rags. Today such materials are too costly to throw away and many plants are finding it profitable to save wipers and other rags for laundering and reuse. Cutting oils are salvaged by extracting the metal chips by means of centrifugal separators. Such reclaimed oils are used over and over again and the annual savings have been known to run well into the five figures.

The details of a salvage system will of course vary with the nature of the plant, but the underlying requisite for any system is the wholehearted co-operation on the part of the personnel. The best suggesters of useful salvage ideas are the ones who can best be developed and trained to submit their thoughts, carry out the plans of the management, and serve as leaders in the general reclamation scheme.



Drawing Conveyor and Car. Note Individual Drive Motor Which Is Enclosed to Protect It Against Dust

CUTTING TIME FROM STORAGE TO JOB

By C. W. Geiger

THE Bay Development Company and the Pacific Gravel Company, at San Francisco, California, have adapted certain of their bunkers to supply crushed rock and sand, cement and water into the Barrymore combined motor truck and concrete mixers which are operated by the Golden Gate Atlas Materials Company in "ready mixed" concrete for street and building construction.

Figures numbers 1 and 2 show the bunker provided by the Bay Development Company and figures numbers 3, 4 and 5 show how the bunkers at the Pacific Gravel Company have been equipped with measuring hoppers for supplying the pre-measured sand and crushed rock, and the water tank for supplying water into the water tanks carried on the combined motor truck and concrete mixer. The Bay Development bunker is a three-story affair, the top being occupied by two hoppers, one for sand and one for crushed rock. The second or mezzanine floor is equipped with two measuring devices, one for the sand and one for crushed rock. Cement is also carried on this floor as well as a large water tank.

The combined motor truck and concrete mixer is an "open-top" supermixer of scientific design, built to fit on the chassis of all standard, popular motor trucks. When it is to be loaded with a batch of material it is backed under the specially built bunkers as shown in figure number 2 and the aggregates measured and dumped into the open top. The gravel or coarse aggregate is first dumped into it and given a fair distribution along the bottom of the body. The cement is then dumped into the center of the load and on top of it the sand. Cement is placed between the gravel and sand to prevent loss in transit. The water tanks are filled with the required quantity of water by means of a flexible hose attached to the end of a pipe leading to the water tank. The truck is then driven to the job.

The procedure of mixing at the job is as follows:

With the motor of the truck running, the driver engages the clutch and starts the mixer. He allows from 6 to 10 revolutions for the dry mix, after which he admits a small volume of water from the tanks. When this amount of water has been incorporated into the mix, an additional amount is admitted. The greater portion of the mixing is done when in the dry state or semi-dry state. After the water has been admitted and the load partially mixed, the driver shifts into the next higher speed. The latter part of the mixing operation is accomplished at from 20 to 25 revolutions per minute. This is very beneficial to the mix as it sets up a decided current in the mass of mixed concrete, and keeps it constantly agitated.

To empty the concrete the driver disconnects the

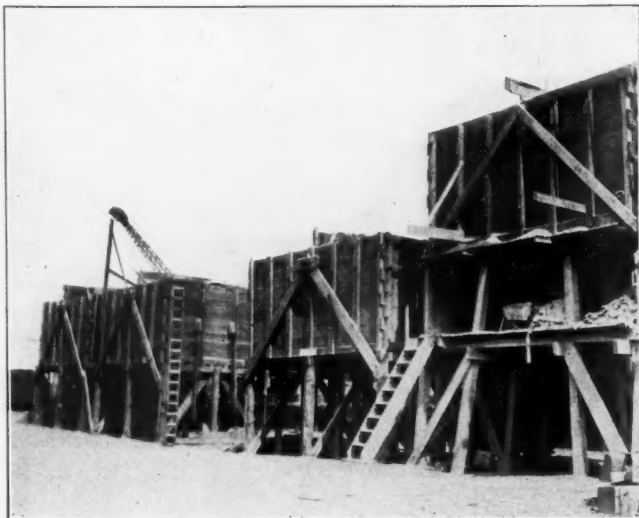


Figure 1. Storage From Which Sand Is Loaded

mixer from the driving mechanism, engages the hoist and raises the body as an ordinary dump. Its semi-cylindrical body enables the mixer to clean itself very quickly through the gate in the rear end.

The mixer is designed to combine three or four distinct operations in the mixing of concrete for construction and paving purposes. It combines the hauling of raw materials with the mixing of them in quantities of from one yard up to three yards of wet concrete. The mixer is rugged simplicity itself and in operation it is much the same as an ordinary dump truck. In fact, the mixer can easily be converted into a five yard, quick discharge dump truck. It is a U-shaped plate steel body, open at the top. The mixing mechanism is a system of spirally placed cast steel mixing blades bolted to a shaft extending the entire length of the U-shaped body. The problem of combining the action of a spiral with a blade which would successfully operate in a mixer of this kind led to the present design of special blades, which give an easy entry into the concrete materials, to give the spading and turning action of a plow, and to give the lifting and puddling action of a shovel.

The mechanical power, furnished by the motor of the truck, is transferred from the driving shaft of the motor through a geared power-take-off through an interlocking male and female gear, thence through a system of reducing gears to the mixing shaft.

Safety appliances are placed upon the levers below the driver's seat which prevent the driver from operating the hoisting mechanism without first disengaging the gears. All controls are so arranged that the operation is foolproof. Gate control, all clutch operations, water valves and dump controls are all easily accessible to the driver and are operated from his seat.

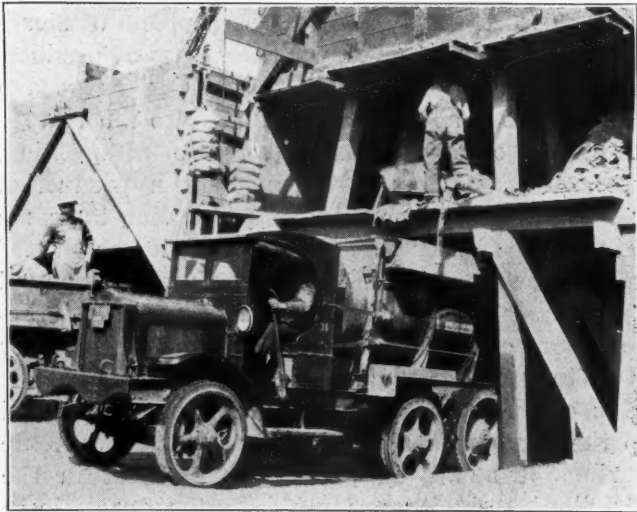


Figure 2. Special Bin and Measuring Hopper



Figure 3. Close-Up of Measuring Hopper

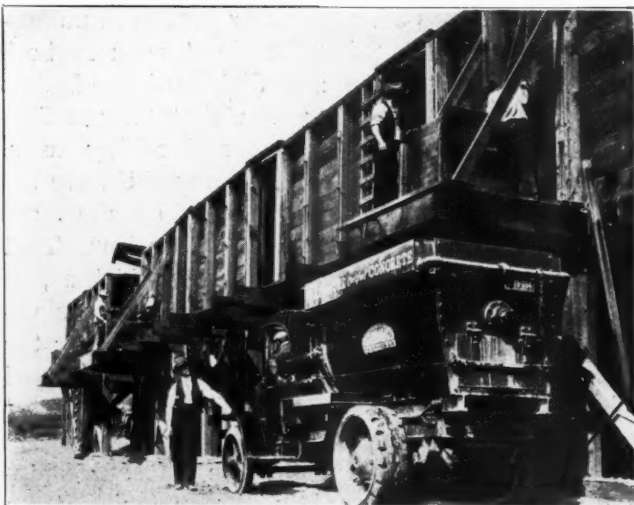


Figure 4. View of Pacific Gravel Company Storage Units

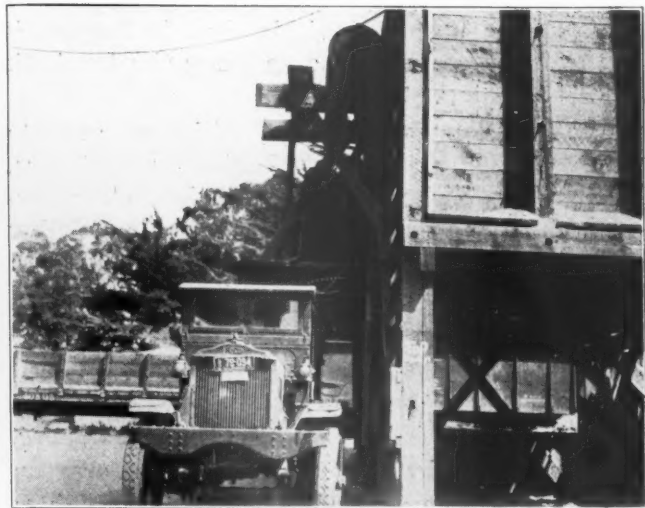


Figure 5. Loading From Storage With Cement, Aggregate and Water

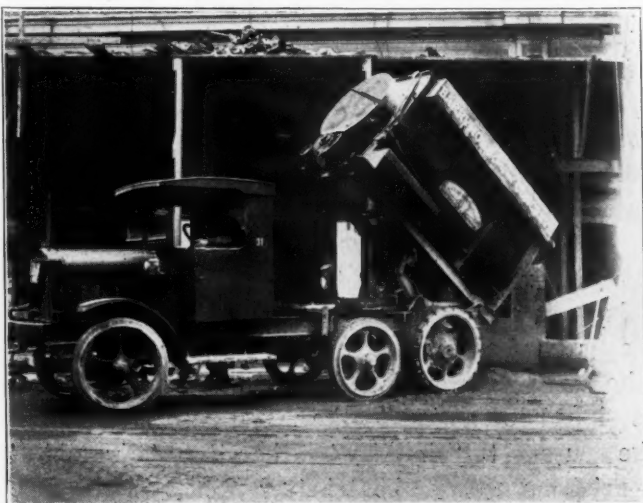


Figure 6. Pouring the Ready Mixed Concrete



Figure 7. Pouring Mixed Concrete

The spiral arrangement of the mixing blades causes the mass of material to move toward the center. Each blade tracks behind the other, cuts through the mass, and thereby lifts, drops and works the material as an individual blade. This individual action of the blades in the mix creates a figure eight movement in one small section of the load. In other words, the overlapping flukes of the blades give a spreading action which causes the particles of the material to go first one way and then the other as they move down half the length of the body. In this way, a very thorough integral mix of the ingredients is effected.

In addition, all blades working in unison tend to carry the mass along as a whole. This action mixes a small section of the load as the shaft revolves and at the same time moves the entire mass toward a central point, where the mass piles to a certain extent, flows back to its beginning and repeats the motion. In the early stages of the operation when the dry materials are first being mixed, the bulking at the center is more apparent. As more water is admitted and the mass becomes more liquid, an obvious current is created within the mix from each end toward the center, thence along the top back to the beginning.

Frequent tests made by authorities on concrete mixing, including concrete technologists, engineers, etc., have established the fact that the motion performed by the mixer gives a very valuable puddling and kneading action which yields a very thorough coating of cement.

Figures 3, 4 and 5 show the facilities at the Pacific Gravel Company for loading these combined motor truck and concrete mixers with aggregate. A measuring hopper is built at the side of the hopper, being supported by an overhanging platform on which the operators stand. The truck is driven directly under this hopper and receives the correct proportion of sand and gravel, the cement being loaded from a truck. Figure number 5 shows the system for supplying water into the tanks, which may be done before or after the proper amounts of aggregates have been supplied.

Because the aggregates are transported to the job dry there is no worry over pre-crystallization or separation of water from cement, as in the case of concrete that is mixed and then hauled to the job. Only at the job is the water released and the mixing started.

Hardening Concretes

The exhaust gases of internal-combustion engines, particularly those using producer gas, are purified and used for hardening cement and lime concretes. Mulliez Freres et Cie. (British Patent 267,971).

Declining Prices and Better Profits

Manufacturers faced with the problem of steadily declining price levels for their class of products encounter another problem in making as good a profit in 1927 as they did in 1926. To illustrate—as prices go down under the stress of competition, the usual course is to hammer down production costs with the hope of at least preserving the same relative margin or percentage of profit per unit of sale. However, this usually means smaller actual money profit per unit, and the problem then becomes one of selling enough more units at the lower price to make the same annual net profit as before. This effort to increase sales volume may so add to the company's cost of doing business that the savings it makes in production are lost in the distribution of its product. In that case, even with the greater volume sold, net profit may not be as good as in previous years.

Therefore, as a safeguard against smaller net profit, R. M. Hudson, Chief, Division of Simplified Practice, Department of Commerce, suggests simplification. It has been definitely proven in numerous instances that "simplification" reduces both the costs of production and distribution. It has likewise been definitely proven that "diversification" adds to both production and selling costs. Yet there are many manufacturers who believe the best way to get more business and to make more profit is to add another number to the line. That would work out profitably more often if they, at the same time, dropped or discarded some slow-moving or seldom-wanted line number, even at the risk of not being able to supply it on an occasional order. The usual practice of striving for greater volume by adding new lines, meanwhile hanging on to all the old ones, soon makes the whole line top-heavy, and inventory rapidly piles up with items that do not turn over. Profits that would otherwise have been made on the live lines are absorbed in the costs of carrying the dead ones in stock. As the variety increases, the burden on plant facilities and the whole production personnel increases, and sooner or later manufacturing costs go up instead of down. The selling organization is pushed to spread its effort over the expanded line, and the consequent diffusion of effort usually increases the cost of selling per unit of sale faster than it increases the total volume of units sold. A minimum consistent range of sizes and grades—all active, carrying no dead weight, made and sold in large volume, even at a smaller cash profit per unit, means good annual net profits. The manufacturer who can thus keep his production and selling forces "stripped for action,"—the manufacturer who has the courage to "simplify" rather than "diversify,"—need not worry about better profits in the face of declining prices.

SPECIFIC HEAT OF PORTLAND CEMENT CLINKER

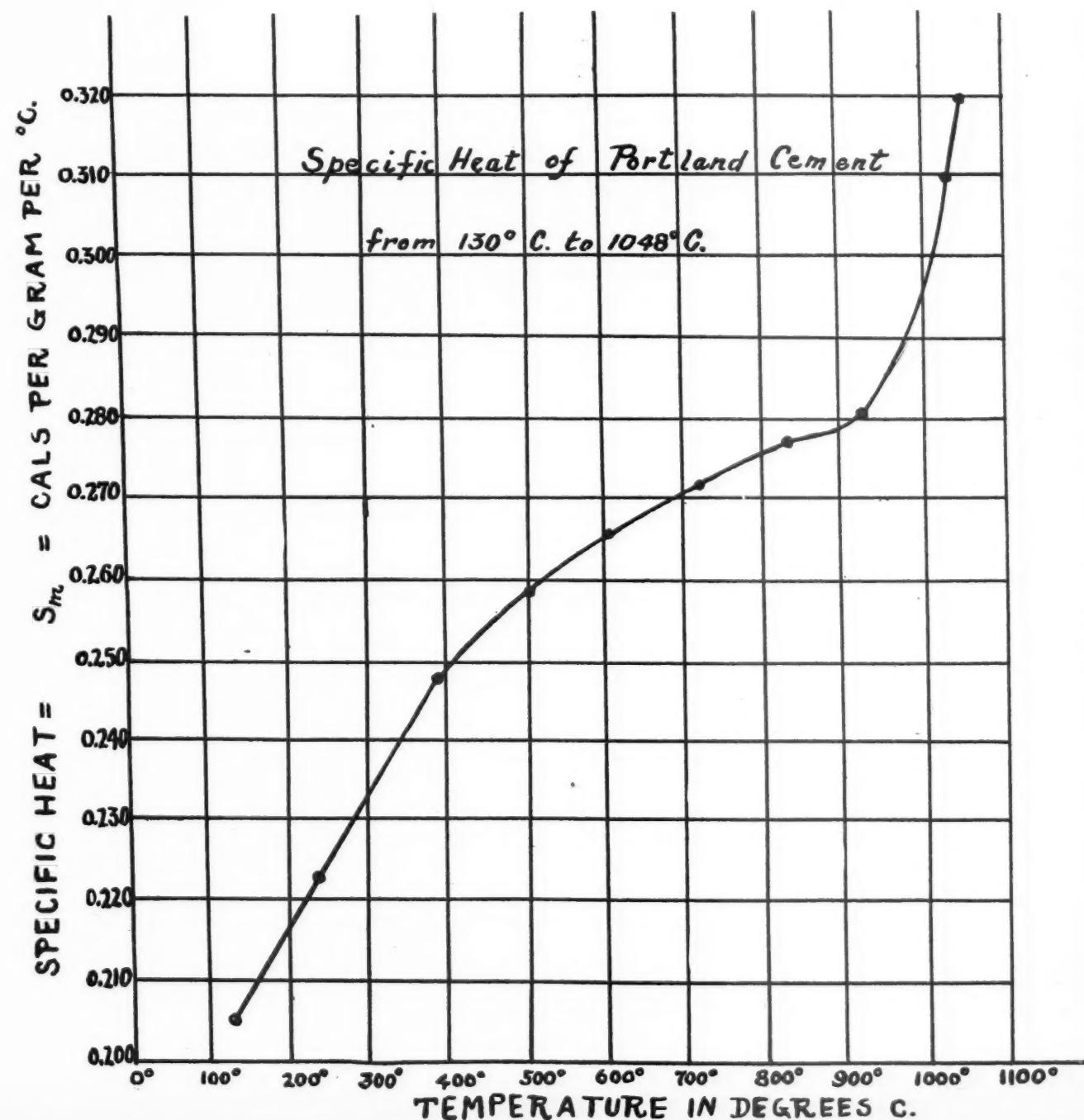
By Fritz Hartner, Jr.*

THERE is only one investigation reported in the literature on the specific heat of portland cement clinker, that made by Hart (Tonindustrie-Zeitung, 1901, p. 1157) in 1901 in which he found s_m to be 0.186 calories in the interval from 25 to 40 degrees C. Strangely enough investigations were not made to determine the change in this value with rising temperature although this has always been of interest from the practical point of view. This may have been due to the difficulty of determining specific heats at elevated temperatures. In the thermal considerations involved in

the cement burning process it has hitherto been usual to assume that the specific heat of the clinker did not vary greatly with the temperature and was about 0.2-0.23 at the kiln temperature.

I have made a series of determinations with a clinker of the following composition:

Loss on ignition	0.14%
SiO ₂	23.26%
Al ₂ O ₃	6.06%
Fe ₂ O ₃	2.58%
CaO	65.80%
MgO	1.40%
SO ₃	0.43%



*Translated from Zement, Jan. 27, 1927, p. 41.

For these tests the clinker was heated in a vertical electric furnace to various temperatures, kept at constant temperature for a time and then transferred by a simple dropping device into a calorimeter vessel (Weinhold-Becher type). The temperature of the furnace was determined electrically, and the temperature measurements in the calorimeter were made by means of a Beckmann thermometer. The water equivalent of the calorimeter was determined by electrical resistance heating before and after every determination. For each test 0.2-0.3 gram of clinker was weighed out. The serviceability of the method was shown by determining the specific heat of copper; the value obtained agreed satisfactorily with that given in the literature.

The results of the tests are given in the following table:

Interval	s_m in cal.	Interval	s_m in cal.
18-130°C.	0.205	18-720°C.	0.272
18-230°C.	0.223	18-835°C.	0.278
18-390°C.	0.247	18-930°C.	0.281
18-500°C.	0.258	(18-1035°C.)	(0.31)
18-610°C.	0.266	(18-1048°C.)	(0.32)

The results are represented graphically in the accompanying diagram:

At temperatures above 1,000 degrees C. the agreement of duplicate results was not satisfactory. I, therefore, offer the figures for 1,035 degrees C. and 1,048 degrees C. only with reservations. It may be said with assurance only that the curve shows a node or point of inflection in the neighborhood of 950-1,000 degrees C. The sharp rise can be explained only by assuming that the inhomogeneous clinker contains some components which fuse at this temperature so that the latent heat of fusion is added to the specific heat.

Farmers Buying Automobiles

Farmers of the United States own 4,528,422 passenger automobiles and motor trucks, according to data published by the National Automobile Chamber of Commerce. This figure represents the registration of farm motor vehicles as of January 1, 1927. It represents a gain of 195,940 vehicles over the registration of a year previous and a gain of 707,337 vehicles over two years before. The motor car is proving a business aid to the farmer, it is urged, as well as a pleasure vehicle for his family.

Texas leads all other states in the number of its farm automobiles, according to the data. In that state farmers own 285,000 motor vehicles. Illinois ranks second with 233,000 vehicles, while Ohio is third with 232,000. The ranks of some other principal states follows: Iowa, fourth; Pennsylvania, fifth; New York, sixth; Wisconsin, seventh; Indiana, eighth; Missouri, ninth, and Minnesota, tenth.

Michigan ranks eleventh although it is the nation's motor vehicle manufacturing center, while Kansas is twelfth and California thirteenth.

Automobile Costs 10.27 Cents a Mile

Operation of the average passenger automobile costs 10.27 cents per mile. This is the conclusion of experts of Iowa State College who made a study of the subject by keeping records of expenses of driving automobiles of many different models. The cars whose records were studied ranged in price from \$400 to \$1,800 and included both four and six cylinder types.

It is likely that many individual car owners can show operating costs below the results obtained by the college authorities who found that costs varied considerably with the different types of vehicle. The costs here quoted represent the average or composite car.

Depreciation is the largest single item of expense and averages 3.16 cents per mile or 30.8 per cent of all costs. It is assumed that this represents the difference between the original selling price of the new car and the price at which it could be disposed of in the used car market. This sort of depreciation goes on, in general, no matter how much care is expended to keep the car in good mechanical operation. The item of depreciation is charged in addition to one of 1.24 cents per mile for maintenance. Gas and oil were found to average 1.92 cents per mile and tires 0.98 cents per mile. Interest and insurance total 1.55 cents per mile.

United States Outselling Others

American business men are outselling the rest of the world in foreign markets. The United States stands at the head of the list of the world's chief exporting countries, according to data collected by the United States Commerce Department.

Approximately \$4,808,500,000 worth of goods were shipped abroad from the United States in 1926 or \$1,031,600 in excess of the value of merchandise which moved from England to other countries. England is the second largest exporting nation, according to the Commerce Department's data which show her total exports as \$3,776,900,000 during 1926. Germany ranks third on the list with exports appraised at \$2,352,400,000, or \$423,500,000 more than France, her former enemy. France's export trade for 1926 was \$1,928,900,000.

Canada, ranking fifth, follows France in the list of chief exporting countries. Then comes British India, sixth, followed by Japan, seventh, and finally by Australia which stands eighth. The United States advance from second to first place in the list during the World War, and England, which formerly headed the list, has never regained her original leadership.

NEW COMPETITION AND THE TRADE ASSOCIATION

By Warren Bishop
Managing Editor, Nation's Business*

IF I were to stand up and say, "Trade associations ought not to be supported," your association secretary would probably rise at once and want to throw me bodily out of the window. And yet, I mean just that. I am sick and tired, and you trade association officers and members ought to be sick and tired of that word "support" in talking about trade associations. A trade association ought not to, and does not, if it is properly managed, ask support, as the Salvation Army asks support. Your trade association is not asking you for money and giving you nothing in return. It is giving you a quid pro quo.

I do not feel when I pay my taxes that I am "supporting" the city in which I live. I am getting in return education for my children, paved streets, water, police protection—Heaven knows what I get. In the same way the trade association is, and increasingly will be, the government of an industry. It provides, and should provide, protection, education and a dozen other things. It should give you, and in most cases it does give you, better than a fair return for what you put in.

If I feel that my taxes are high and our schools bad and our streets poorly paved, then surely I have a right to complain. So, too, has every member of the trade association a right to complain if he is not getting his money's worth. But what I do object to is to have him feel that he "supports" a trade association as he supports a "Sunshine League" or a charity that someone had told him is doing good, but of whose work he has no knowledge.

There are, it seems to me, two great major forces in modern business which are making the trade association not merely useful, but inevitable. One of these is the growing tendency of the Government to encroach on business, either by going into business itself or by increasing its regulation of business. The other force is what we have come to call "the new competition," and by that I mean the struggle between industries and between materials rather than the old-time competition between individuals.

I have no intention of discussing with you the problems which are peculiar to your particular industry. You know too much of them, and I know too little. Yet the things which affect one business, in general affect another. Take for a moment this question of government regulation. It is perfectly easy to imagine a proposal for farm relief which would take the form of a suggestion that the Government enter the business of manufacturing and selling fertilizers at cost. I am not sure it has

not been suggested. In any event, no unit in your industry can face that situation alone. It calls for the organized effort and the organized intelligence of them all.

Let me point out a condition which threatened in my own trade, that of periodical publishing. You may recall the Federal Trade Commission's ruling in the Ostermoor mattress case. The Commission ordered the manufacturer to change his advertising, on the ground that a picture showing one end of a mattress cut open and spreading out was untrue. The Commission said, in effect, that no felt mattress would expand as much as that picture indicated. There was a member of the Trade Commission with a saving sense of humor, and fortunately, a Circuit Court of Appeals which saw things by the light of common sense. The Commissioner, in a minority ruling, and the Court, in a majority decision, held that advertising could not be held to a literal truth, that a certain amount of accepted exaggeration was pardonable.

But the point I am making is this: If the Federal Trade Commission ruling had been upheld by the Court of Appeals, we should have had then a censorship of advertising by the Government, with untold consequences. Suppose each copy of every magazine had to be submitted to the Government and that its advertising might be O. K.'d for literal truth. It takes no imagination to see the problems that would confront my industry. You will recall one brand of condensed milk which advertises "milk from contented cows." One of our staff pointed out, after reading the Ostermoor decision, that if that held and the Federal Trade Commission could find one unhappy cow, the advertising would have to be rejected.

I recall a coffee advertisement which caught my eye the other day. It said, "Once tasted, the flavor is never forgotten." Neither you nor I believe that literally. We know what the advertiser means, and we are sensible enough to accept it; but once you put this industry in the hands of Government regulation, then there is no limit to the extent to which rules might be carried, for Government lives by rule and thrives on red tape.

I could multiply these instances indefinitely, and I should be far from saying that industry itself is without fault. Until industry learns to regulate itself from within, it must fear the regulatory hand of Government from without; and that is the point I would make—that no individual industry can regulate itself, not even the Standard Oil Company or the United States Steel Corporation. No industry alone is big enough to deal with Government. It is the industry as a whole that must act.

*Presented before the National Fertilizer Association at White Sulphur Springs, June 8, 1927.

Let me illustrate the new competition and its importance in modern business and in the trade-association movement from my own industry. It is, as most of you know, an industry in which the by-product has come to assume a major importance. The advertising tail is, in the financial sense at least, wagging the circulation dog. In other words, advertising is the larger source of revenue of most publications. But there is nothing wrong in that. Advertising depends on circulation, and circulation depends on sane editorial methods. We cannot get continued patronage of our editorial product and continued reading of our advertising pages unless we are giving our customers something that they want at a price they can afford to pay. And that is as true of an editor's manufacturing job as it is true of a maker of pies or of automobiles.

But—and this is a large but, and I think it will be a bigger but—this advertising which finds its place in newspapers and magazines is threatened with a "new competition." The buyer who has kept constantly alert to the virtues of Somelad's Soap by appeals to the eye is now getting a chance to hear of it through an appeal to the ear. The radio, which is a publication industry on a tremendous scale, has vast possibilities as an advertising medium—how vast I dare not say, for the radio, as I sense it, is today about where the automobile was when the cry, "Get a horse," was still ringing through the land.

We know—we in the magazine industry—that the radio can do many things which we cannot. It can sandwich music with economics and business forecasts, or serve its fiction with jazz. For the moment, we can do something that radio cannot. We can illustrate; we can use photographs, drawings and charts to make clearer what we have in mind. But Heaven only knows how long we shall have that advantage. A distinguished scientist said to me not long ago:

"I heard the last inauguration from a point 300 miles away. I confidently expect both to hear and see the next one from perhaps the same point."

There's the new competition with a vengeance. And the newspapers are not unmindful of it. At present your newspaper has the advantage of giving you a personal selection. If you don't want the golf scores, you can read the murders or the stock market reports. With the radio you may leap from city to city and from dance music to helps for the helpless, but you can't always get what you want when you want it.

But suppose some inventive genius—and I'm not suggesting anything half as remarkable as the phonograph or the telephone seemed a generation ago—suppose this inventive genius devises a radio that records the incoming reports and keeps the record so that I am free to go back over the day's news and pick out what I want or to go ahead with the happenings of the immediate present! What

then, of the new competition for the newspaper?

This competition of the radio in reading matter and in advertising is at hand, but it is not all the periodical has to face. The man who sells magazine space must not only be ready to tell why his magazine's pages are desirable as compared with other magazines, but he must meet the competition of the newspaper and the outdoor poster. And, I might add, the morning paper is battling bravely with the evening as to which hour of the day is more apt to find readers responsive to advertising.

In many industries it is the contest of material with material that is engaging attention. If for a moment you have any doubt of this, let me recommend to you that you try building a house. You will, I presume, put some plumbing fixtures, some piping, into this new house of yours. Will it be the battle of Plumber Jones against Plumber Smith which you will have to decide? Not much! What you will have to settle will be the fight between Copper, Iron and Nickel. Copper will say to you: "Put me in and forget me. I last forever. Corrosion is nothing to me." Copper's rivals will answer: "Look at his price." And Copper answers: "Yes, but I'm more than worth it."

Of what will you make your outer walls? Wood is ready with its case; Brick is prepared to prove that one might as well live in a cave as in a house built of anything but brick; while Stucco and Hollow Tile are asking to be heard and Sheet Steel is getting his case ready. And if you decide on wood, then Woods stop arguing against Brick and Tile and Steel, and prepare to prove that Cypress or Pine or Fir is, of all woods, the one wood for you.

With what will you roof your house? Tile? Asphalt? Wood shingles? Copper? Slate? The list isn't ended there. And having erected it and roofed and floored it—and flooring is barely getting into the battle, for the man who is trying to sell you a composition sole for your shoes will soon try also to sell you a composition carpet on which to wear out those soles—what will you do, say, for refrigeration? Will you have cold brought in on the ice man's back in a solid lump, or will you have it run in over an electric wire? Ask the builders of refrigerators and the makers and sellers of ice what they think of the new competition.

And how will you heat your house? Oil is pressing in on coal. The man who yesterday sold you coal and warned you that oil was uncertain and expensive is now calling you up to tell you that he will deliver either oil or coal; and your ice man may yet turn himself into an electric refrigeration expert.

And electric refrigeration itself, newcomer as it is, has hardly started its fight on ice when a new competitor enters the field. At least two companies in New York are manufacturing a "dry ice," a solid form of the carbon dioxide with which we are all familiar in our soda-fountain drinks. It can do some things that ice can't, some things that

electric refrigeration can't. It has not found its place yet, but it will, and we shall have not a two-sided battle, but a three-cornered battle, and those three corners may become four, for gas refrigeration has yet to be really heard from.

Gas is not satisfied merely to cook your food and face the possibility of defeat at the hands of the electric range. By no means! The gas industry has summoned its first line of attack, its engineers and its chemists, and it is preparing both to heat and cool your house by the same gas engine in the cellar. Far away? I don't know. If I should say, "Yes," I might well be lining myself up with those who said, "The telephone is an interesting toy, but has no commercial possibilities," or with that other prophet who said, "If God had meant men to fly, he'd have given 'em wings."

Let's take one more look at "the new competition" from a more intimate standpoint. Grandmother knew wool and cotton and silk. She wore woolen in winter, cotton in summer and silk on Sunday. Now her granddaughter has infinite varieties of these, plus rayon, to take the place of cotton and of silk; new methods of manufacture plus a higher standard of wages and increased earning power have made the silk stocking not something to dream about as a bit of finery, but a commonplace of every-day life. And what about the manufacture of cotton hose?

"Let me write the songs of a nation, and I care not who makes its laws," said some wise man. If I were a manufacturer of textiles, I think I should say: "Let me know about the underwear habits of a nation a year or two in advance, and I don't care much who weaves the textiles."

A generation or so ago everyone wore knitted underwear for most, if not all, of the year. Now you and I are wearing athletic or union suits of cotton 12 months a year. As for what our wives wear, that's nobody's business, but it doesn't run to red flannel. There again the new competition has overturned an industry.

I have mentioned wood as hard fought by this new competition in the construction industry. Not long ago the secretary of the National Lumber Manufacturers' Association compiled for his members a list of 22 materials which were definitely in the field to replace wood. They were, he said, spending \$30,000,000 a year in promoting the use of substitutes for wood. And his list was by no means complete. He did not mention, for instance, that one of the big steel manufacturers was turning out what they call a "Junior I-Beam," by which structural steel can enter into competition with wooden beams as material for dwelling houses. At present the lumber industry is fighting this new competition with the weapon of price. Steel beams cost more and are not worth the difference. That is, in effect, the first answer. But price is not a very dependable weapon in these days of large production and constantly improving methods. If the

public responds to the proposal that it build houses with steel beams, increased demand may very readily result in decreased prices.

Only the other day I saw an announcement from the Celotex Company which said that their daily factory shipments took the place of 22 carloads of lumber, a statement not calculated to please the lumber industry. There are other uses of wood which are being threatened, just as, in turn, wood is threatening other substances. In fact, I suppose that one of the most dramatic instances of this new competition was the invasion of the paper-making business by wood pulp.

We are all familiar with the synthetic resins, like bakelite—that is, we are familiar with them in the shape of pipes, electric fittings and umbrella handles. It is difficult to visualize them as materials for furniture, but the manufacturers of these substances have an eye on the furniture industry. They have handicaps to overcome; cost is one, and weight is another. Yet they feel that bakelite may yet supply us furniture of all colors, of varying degrees of transparency and highly resistant to scratches and stains. All still in the future, yet indicative of the way in which industries in these modern times must keep their eyes open.

Steel may be trying to crowd wooden beams out of our houses, but is steel so secure as a structural material that it need not worry? Only 2 or 3 years ago, speaking at a meeting, I think of the Iron and Steel Institute, a chemical engineer referred to the vast available supplies of aluminum and suggested that with cheaper methods of extraction and new methods of hardening we might yet see structural steel beams replaced by much lighter aluminum beams with vast effects on our ideas of skyscraper building.

How is this new competition to be met? There is no one weapon that will serve every industry which finds itself facing competition from without. There are certain things, however, that seem to me to hold good in almost every case. One is that the battle is too big for any individual. The new competition calls for an organized industry—for the trade association at its best.

Let us take a wholly fanciful, but not impossible case. One of our great industries is the manufacture of rubber tires for automobiles. It is an industry firmly settled. I am told that it suffers from an ability to overproduce. Waddill Catchings, the banker who is a director of Studebaker and Goodrich, says that there are some hundreds of factories making rubber tires in this country and that 4 or 5 of them could produce all the tires needed by the United States. It is an industry that has, I think, a fairly accurate measure of the capacity of the country to consume tires. Our statistics of automobile production and use are unusually complete.

But suppose this industry finds itself facing a sudden competition from without. Synthetic rubber may replace natural rubber; the development

of air transportation might cut in two our consumption of rubber for tires. Such developments do not happen overnight, it is true; but they do come quietly, so quietly that they may catch an industry, or at least the individuals of that industry, napping.

How can this competition from without be faced except by an industry working as a whole, marching shoulder to shoulder through its trade association? In that picture of rubber I have drawn there are obvious things that the tire industry might do. It might accept the substitute and devise means to adapt its factories to the new product; it might so improve its methods of production, of purchase of raw materials, of marketing its finished product, that it could successfully fight off the substitute; it might so skilfully set forth the virtues of natural rubber that the new rival would find itself lagging behind. If the industry should find, as I have suggested, that air transportation has cut the tire market, then it may seek new uses, new markets for rubber. But you may be sure of one thing: that the industry as a whole, acting as a "Committee on ways and means," is the best method. As great a test of generalship as any, perhaps, lies in knowing when to retreat. And this test has to be faced by any industry which finds itself threatened by a new material, a new method, or by a new habit of living.

I have spoken of knit underwear. It is easy to see the problem which that industry faced and to see how many factors threatened it. Steam-heated houses and offices have made us accept lighter underwear. Cheaper natural silk and the production of artificial silk helped to make the female of the species indifferent to wool. There was a very great change in the clothing habits of the nation.

What should the knit underwear industry do? Accept the inevitable and look for other use for their looms? Or should they fight and endeavor again to change the habits of the nation? One method suggested, and for a time followed, was a national advertising campaign to set forth the superior healthfulness and comfort of knit underwear. How successful that campaign was, I do not know, yet it is difficult to make a country again change its living habits once it has adopted new ones.

In the last quarter-century I suppose the most striking instance of this new competition was the invasion of the automobile as a means of transportation. If you had been a manufacturer of carriages in 1900, what would you have done? It's easy to say now, but it was hard to say then. If the history of that period of the nation's business were written, it would probably be found that some manufacturers stood with their backs to the wall and fought. They went on making carriages and insisted that there would always be markets for them. Yet I read a year ago in a carriage trade

paper that it was no longer possible to buy a "buggy"—a disappearing word, by the way—on the Island of Manhattan, with its more than 2,000,000 inhabitants. Other manufacturers turned over to the automobile industry, making cars or parts of cars; still others, I have no doubt, went to manufacturing other products.

But the effect of the automobile invasion has not only been felt by the breeders of horses and the makers of carriages and wagons and harnesses and whips. The manufacturers of men's clothing know that it has gravely affected them. The silk hat has certainly suffered. Men, they feel, are neglecting their dress. Only the other day I heard that the men's clothing and shoe industries had under consideration a project for a campaign of publicity to stimulate men's pride in their appearance.

Just the other day a letter invited Nation's Business to be represented at a conference on bituminous coal, at which two German chemists and a French scientist described methods of making synthetic alcohol, petroleum and gasoline from coal. It is not impossible that this form of new competition may end the talk of conserving petroleum and lead the petroleum industry on a hunt for new uses and new users.

The business of making music in the home gives us an interesting instance of the new competition and the ways of meeting it. A generation ago if little Alice gave signs of breaking out with musical talent, or Mother decided that there was money enough to put on a little extra show, there was one chief answer—a piano in that room which we used to call a "parlor." And the competition was highly individual. Chickering, Steinway, Bradbury, a dozen names would come up, some of them now passed out, some still active.

When the first talking machines came squeaking into use, what was the attitude of the music industry? Rather contemptuous. "Canned music" was a common phrase. But the phonograph proved itself a very real competitor. When in time the radio entered as a competitor of the talking machine, the latter industry was much quicker, I fancy, to recognize that a new and dangerous rival was on the battlefield. There was in more than one case an adoption of the new device by the older industry; the radio and the talking machine joined hands and offered themselves to the consumer in a single unit. Perhaps some day the piano, the phonograph and the radio will all be offered in one container. It wouldn't surprise me if this were already being done. And after listening to some pianos, some radios and some phonographs, I think that such a combination would have one tremendous advantage—the whole combination could be destroyed with a single axe.

A very interesting illustration of the tendency of an industry in the beginning to fight the inevitable and then to adopt it is in the competition which

first the street railways and then the steam railroads found in the automobile, bus and truck. Our city street car lines began largely by abusing the obnoxious "jitney," by devising means for its regulation or its expulsion. Now it has dawned on most street railroads that primarily they are merchants of transportation, and that it is up to them to sell to the public the kind of transportation which the public wants to buy, whether it runs on rails or rubber.

Increasingly the street railroads are running buses. They have met the new competition by absorbing it. And the American Street Railway Association and the National Automobile Chamber of Commerce, two active trade associations, were instrumental in bringing their members around to this point of view. The same thing is true of the railroads. At a recent meeting with the Interstate Commerce Commission there were represented more than 50 railroads which were running trucks and buses. Yet only recently the railroads were fighting this competition.

You can readily recall them—sauerkraut, sheet steel, copper and brass, Southern Pine, leather—they are all fighting to sell you their goods. If you are a devoted reader of advertisements—and one of the things that saddens an editor's life is that so many men will say to him, "I do think that nowadays the ads are the most interesting part of the magazines"—if, as I say, you are a reader of advertisements, you will have noticed that increasingly individual advertisers are not waging war with a rival manufacturer, but with a rival product.

Only the other day my eye fell on the last page of *The Saturday Evening Post*. The page was devoted to the praise of the banana. The banana was running over with protein and carbohydrates and vitamins as well as tasting like a banana. It was an impressive advertisement. It made me want to eat a banana. But, nowhere, save in a very small type, did it say who inserted the ad. It didn't ask me to eat Smith's bananas, just eat bananas. It was part of the banana's fight in the competition with other fruits. Oranges have, perhaps, threatened the banana, and the latter is ready to answer.

Advertising is a powerful weapon in this new competition, but like many another weapon, it is useless except in the hands of one who can use it skilfully. Proper association advertising must have as its basis a right understanding of the uses and advantages of the association's products.

The search for new markets, which is another of the means of meeting this new competition, is going on at a tremendous pace. Automobile makers long refused—at least in public—to admit that there is any such thing in sight as a saturation point, yet they are conducting through their national association a remarkably well planned campaign for export trade.

One defense against this new competition which I can only touch upon briefly, but which I believe will play an increasingly greater part, is simplification. Long-established industries which suffer from a multiplicity of styles and sizes due sometimes to the very fact that they are long-established, may well find that in meeting the new competition of new materials it pays them to consider standardization. The newer industry is perhaps not yet suffering from that evil; it is not like older trades, doing 90 per cent of its business in 5 or 10 per cent of its sizes. Here again is a task that demands a well organized trade association.

The magazine of which I am one of the editors, and its owner, the United States Chamber of Commerce, stand definitely upon a platform for business which, among other planks, asserts: That business should right its own wrongs; clean its own house; and that if business doesn't, government will. That organization is essential in industry if it is to achieve the best results not only for itself, but for the public. And these two principles are sound in dealing with the new competition. No man can watch alone!

Eleventh Annual Chemical Exposition Promises Much Interest

Recent developments have been so rapid and far-reaching in the fields of chemistry and chemical engineering that unusual importance attaches to the Eleventh Annual Exposition of Chemical Industries to be held in the Grand Central Palace, New York City, September 26 to October 1.

Particular interest has been shown toward the sections of the exposition devoted to synthetic products, lacquers and the machinery and container sections. These sections already have listed a number of exhibits that will appear for the first time either in domestic or foreign markets. Among other important exhibits will be that of Vita glass, which permits the passage of ultra violet rays from sunlight, thereby transmitting the life-giving rays which ordinary glass will not permit. This year for the first time in the history of the exposition, the doors have been opened to foreign exhibitors and domestic consuming manufacturers are anxiously waiting to see the displays from abroad and compare such products with what they are now using. This will particularly apply to dye and synthetic products as well as to foreign methods of handling and equipment used in the way of instruments of precision.

In the past decade the world has come to realize as never before the value of scientific research, not only to industry, but to life itself. Progress along these lines, though sometimes apparently slow and tedious, has brought some startling developments in every branch of industry.

STUDYING ACTION OF INORGANIC OXIDES ON ALUMINOUS SILICATES

By B. Garre*

ONE of the very interesting subjects for research in the cement and stone field has been the action of inorganic oxides on the alumina-containing silicates when the mixture is subjected to heat. Not very much work has been done along these lines and for this reason the article which was published in *Zement* and which is given below, containing as it does a report of investigations that were carried out in the Testing Laboratories of the Technical High School at Danzig-Langfuhr in Germany, is of considerable importance and interest to all cement men.—*Translator*.

Our knowledge of the behavior of inorganic oxides on alumina-containing silicates as well as artificial and natural silicates is but slight. Inorganic oxides are often brought into contact with cement, as for example in the manufacture of colored cement tile and the like, which means in coloring cement. The ceramic industry uses oxides as a flux for making glazes to a large degree.

An article has appeared in *Zement*, 1926, number 46, pages 844ff., on the action of barium oxide and strontium oxide on silica and alumina on heating. Tammann and Grevenmeyer (see *Zeitschrift fuer unorganische Chemie*, volume 136, page 118) have heated natural, alumina-containing silicates with barium oxide and were unable to note any change at temperatures in the neighborhood of 600 degrees C.

When dry strontium oxide is mixed with the following dry silicates and if the mixture is then heated, after it has been stamped down somewhat in the crucible, for a period of five minutes at a temperature of 600 degrees C., and then a sample is subjected to analysis by extraction with a one per cent solution of acetic acid, to which a little ammonium acetate is added, then it is found that the following quantities of silicates are decomposed. Furthermore, the following tabulation also contains the decomposed quantities of alumina and silica in the converted silicate.

TABLE NO. I

	Silicate Pct.	Alumina Pct.	Silica Pct.
Nephelin ($2\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot \text{Na}_2\text{O}$)	10.3	77.1	22.9
Leucite ($4\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot \text{K}_2\text{O}$)	7.8	79.3	20.7
Orthoclase ($6\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot \text{Na}_2\text{O}$)	6.1	76.4	23.6
Precipitated silica			2.2
Quartz			1.9
Alumina		13.2	

The heating curves of strontium oxide with quartz and precipitated silica show at a temperature of 450 degrees C. a clear deviation of the

heating curve from the kiln curve. The action of strontium oxide on orthoclase, leucite and nephelin begins at a temperature of approximately 435 degrees C. The deviation of the heating curve from the kiln curve is greatest in the case of orthoclase towards the quartz side, and smaller in the case of leucite and very small in that of nephelin. No deviation of the first heating curves from the second can be established when mixtures of strontium oxide and alumina were tested.

When a mixture of strontium oxide and silicates containing water is used, then the beginning of the reaction is much more clearly defined. Nevertheless, the initial temperature was essentially the same. It therefore appears that the presence of water in the mixture has no effect at all or scarcely any on the temperature at the initial point in the reaction, but it does appear to have a considerable influence on the speed of reaction.

Inasmuch as the surface between the first and second heating curves is proportional to the product of the heat of reaction and the mass in moles, then it follows from the conditions that have been described between the first heating curves and the kiln curve that the heat of reaction, which is evolved by the reaction between strontium oxide and alumina, must be much smaller than the heat of reaction evolved in the reaction between strontium oxide and silica. The deviation of the first from the second heating curves then naturally increases due to this fact as the content of silicic acid in the silicates increases.

In spite of the fact that the heat of reaction in the case where alumina is substituted for strontium oxide is considerably smaller than in the case where silica is substituted for strontium oxide, the alumina in the silicate, as may be seen from tabulation number I, is considerably more strongly attacked than the silica. It is also true that pure silica will be decomposed to the extent of two per cent approximately, while 13.2 per cent of the pure alumina enters into the reaction, although no development of heat is manifested according to the heating curve with alumina, while the development of heat in the case of silica is considerable. The degree of the double decomposition in reactions in the solid state is consequently not entirely conditioned by the heat that is developed during the reaction, but only by the diffusibility of the initial components through the reaction product. The alumina in leucite was most strongly attacked of all the silicates that were investigated. Methods of making alumina by heating silicates which con-

*Translated from *Zement*.

tain alumina are therefore most promising when leucite is used.

Lead Oxide and Silica

It is to be expected that lead oxide, due to the great similarity that it bears to alkaline earth oxides, such as lime, strontium oxide and barium oxide, which act so strongly on silicates and alumina, will likewise have a strong action on alumina-containing silicates. Experimental investigation of this behavior has, to be sure, shown that the reactivity of lead oxide is not very much less than that of the alkaline earth oxides themselves.

Mostowitsch (see *Metallurgie*, volume 4, pages 647, 55) heated lead oxide and silica in different proportions up to the melting point and then as soon as the mass showed signs of sintering, the temperature was brought back again to the point where it stood at the beginning of the reaction, which means in the neighborhood of 700 degrees C. Hilpert (see *Berichte*, 1910, pages 2565ff.) has worked out a diagram of state of matter for mixtures of lead oxide and lead metasilicate. The two lowest eutectic point at which $3\text{PbO}_2\text{SiO}_2$ and $\text{PbO}.\text{SiO}_2$ are in equilibrium with one melt and $2\text{PbO}.\text{SiO}_2$ and $3\text{PbO}.\text{SiO}_2$ with another melt lie at 675 degrees C.

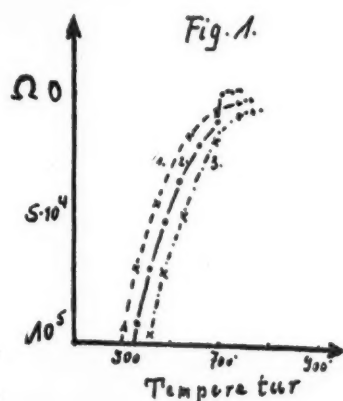


Figure 1.

There are no noticeable deviations between the position of the first and the second heating curves at a temperature of 710 degrees C. in the case of those heating curves which are obtained with mixtures of dry lead oxide and dry quartz, as well as silicates and alumina. Inasmuch as the method of deriving the heating curves for these mixtures revealed no information on the course of the reaction, it must be followed out from stage to stage by making analysis of the mixtures which were maintained at the desired temperatures for a period of one minute. In order to determine the amount of lead oxide that had been converted, the reaction product was extracted with an alcoholic solution of acetic acid. This kind of a solution is expressly used for the reason that the lead silicate would be immediately decomposed by an aqueous solution of the acid. This solution contains one cubic centi-

meter of acetic acid and one gram of ammonium acetate per hundred cubic centimeters of alcohol. The extraction is carried out over so long a period until the extracting medium no longer absorbs lead oxide. The lead is then precipitated in the form of lead sulphate and thereafter weighed after the addition of water to the filtrate and evaporation. The various quantities of lead oxide that were found to enter into reaction are given below in tabulation II.

TABLE NO. II.

Heated up to	600° C.	650° C.	710° C.
Nephelin	6.5%		27.7%
Leucite	5.6		21.8
Orthoclase	3.9		13.2
Precipitated silica	4.0		...
Quartz	3.1	8.0	23.5

The mixtures of lead oxide and silicate cake together to a certain degree after they have been heated. The color of the mixtures changed, becoming somewhat lighter than they were at the beginning. Curve 1 in figure 1 shows the electrical resistance of samples two millimeters thick made of lead oxide. The resistance decreases very strongly below the melting temperature, which lies in the neighborhood of 876 degrees C. The electrical resistance curve of the mixtures of lead oxide with silicates is shown as curve 2 of figure 1. In this case the decrease in the resistance begins at a somewhat higher temperature and from a temperature of 675 degrees C. the resistance decreases in a discontinuous manner from 2×10^4 ohms to zero ohms, for it is just in this portion of the heating that the aforementioned eutectic mixture is formed at 675 degrees C.

If equimolecular quantities of lead oxide are heated with quartz and silica glass, whose particle size is made as uniform as possible and amounts to 0.005 millimeter, over a period of five minutes, at a temperature of 600 degrees C., then the decomposition in the case of quartz is 5.1 per cent and that in the case of silica-glass is on the other hand as much as 12.3 per cent. It is known that solutions act on the same substances in the isotropic condition much more rapidly than on the same substances in the anisotropic condition. The same rule also holds good for reactions that take place between powdered substances.

Lead Oxide and Alumina

Up to a very short time ago nothing at all was known regarding the action of lead oxide on alumina (see B. Garre, *Chemiker Zeitung*, 1926, number 85, pages 616ff.) Lead aluminate is not obtained from the aqueous solutions. Then again, the substance is also not formed by melting together lead oxide and alumina. For when this is done, the lead oxide begins to volatilize at a dark red heat, and such volatilization becomes very marked indeed at a temperature of 900 degrees C. The lead oxide melts at a temperature of 879 degrees C.,

without having entered in any very marked degree into combination with the alumina which melts only when the temperature has reached the high point of 2,010 degrees C. Lead oxide combines with alumina, when the two components are mixed together in as fine a state of subdivision as possible, the mixture being very thoroughly made, and heated over a prolonged period of time at a temperature of approximately 700 degrees C. The yellowish appearance of the mixture at the beginning is gradually changed and it eventually becomes white. The formation of the white product takes place accordingly in the solid state. The correctness of this assumption may be proven by making electrical resistance tests on pressed samples of the mixture. Discontinuous decrease in the resistance, as shown in curve 3 of figure 1, is not found. The following tabulation number III shows the various quantities of lead oxide that enter into the reaction when a mixture of lead oxide with quartz and alumina is heated.

TABLE NO. III

	Heated up to a temperature of		
	600 deg.C.	650 deg. C.	710 deg. C.
Quartz . .	3.1 per cent	8.0 per cent	23.5 per cent
Alumina .	15.1 per cent	.....	42.1 per cent

Alumina is attacked to a considerably greater degree by lead oxide than is silica. It therefore appears to be quite common that basic oxides will exert a greater action on the alumina than on the silica at lower temperatures. This fact can be made use of in cleaning bauxite, by mixing the same with soda and then heating the mixture to the point of redness, that is, below the melting temperature of the soda. Anhydrous aluminates will be formed in this manner, while the silica and the iron will not go into solution.

Hence lead aluminate is easily formed in the solid state, and this substance can scarcely be prepared by melting, due to the great difference between the melting points of the component parts, and the strong corrosive action on the walls of the crucible or vessel in which the melting takes place.

Canavall (see *Zeitschrift fuer prakt. Geologie*, volume 18, 460, 61, Nov. and Dec., 1910) melted the silicate with lead oxide in order to be able to detect alkalies and titanium dioxide in a green shale. After the melt had been decomposed with the aid of acids both the alkalies and the titanium dioxide could be distinguished. The possibility remained that silicates could be reduced in the solid condition by the aid of lead oxide, when the reactions were carried out by repeated heating to the temperature of 650 degrees C. and reducing the substance to a powder after it had been completely cooled. When this procedure was carried out it was found that the very important advantage was gained in that the crucible used was scarcely attacked by the melting substances.

The investigation of the behavior of inorganic oxides (not including those that make up the composition of cement) with cement and the materials that are made from cement has been given but little attention up to the present time. There is scarcely a field, which has been worked in to so slight a degree from the scientific standpoint, although the information that can be there obtained is of considerable importance not only from the theoretical standpoint but from the practical as well.

International First Aid Contest Open to Quarries

The dates for the Sixth International First-Aid and Mine Rescue Contest, recently announced as to be held in Pittsburgh, Pennsylvania, have been fixed for the three days, August 30 and 31 and September 1. The first-aid contests, in which teams from coal and metal mines, quarries, and oil-producing and refining companies from numerous states will compete, will be held at Duquesne Gardens. The mine-rescue meet, which will be participated in by teams from widely-scattered mining communities, will be held on the campus of Carnegie Institute of Technology. The contest will be given under the auspices of the United States Bureau of Mines, Department of Commerce, in co-operation with the Pittsburgh Chamber of Commerce.

Various prizes will be awarded the teams which, in the opinion of the judges, prove themselves most efficient in first-aid and mine-rescue methods. Each first-aid team will be composed of six men, including a "patient." Each team will be required to perform three or more definite problems in first-aid, calling for the treatment of injuries and the proper handling of the patient. The patient, assumed to be suffering from electrical shock, arterial bleeding, broken bones, or other injury, will be given the first-aid treatment prescribed in the manual of the United States Bureau of Mines. The events will be judged by doctors and expert laymen skilled in first-aid training and conversant with the Bureau of Mines first-aid standards.

The competing mine-rescue teams will be composed of five men provided with oxygen breathing apparatus and other necessary equipment used by rescue crews in coal and metal mines. The team will be required to work out in a specially prepared smoke room a practical problem such as is likely to be encountered in underground rescue operations.

The International First-Aid and Mine-Rescue Contests are held each year under the auspices of the Bureau of Mines, with the cooperation of the National Safety Council, the American National Red Cross, and various mine operators' associations and miners' organizations.

MINING FLORIDA LAND PEBBLE PHOSPHATE

By W. H. Taylor,
Superintendent, Coronet Phosphate Company

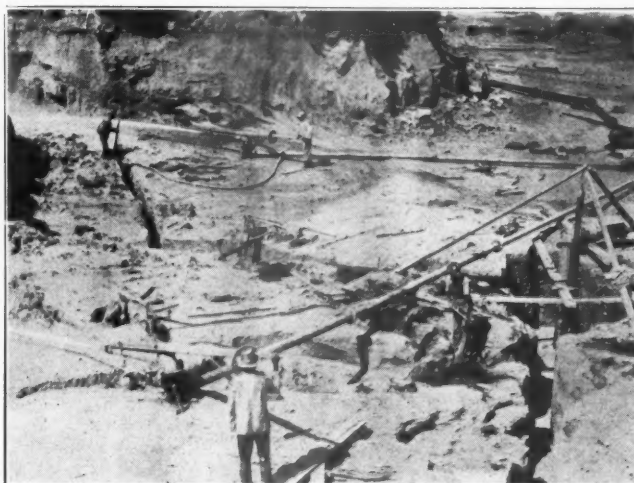
THE majority of the minable area of pebble phosphate deposits in Florida is included in the small area of Eastern Hillsborough, and South and Western Polk Counties. It occurs, more or less, in pockets, and is located by prospecting, which is done by boring anywhere from sixteen to thirty-two holes to the forty acres with a four inch auger. The overburden varies in depth from about five to fifty feet, and the deposits about in the same proportion.

The overburden varies in composition from loose sand, iron and sand rock to hardpan. In the case of the latter, extensive blasting is necessary in order to move it. The deposit consists of pebbles that vary in size from that of a pin head to a hen's egg, embedded in either a clay or sand matrix, or sometimes a mixture of the two. The richness of the pebbles in the matrix varies anywhere from two to twenty thousand tons to the acre, and anywhere from ten to fifty per cent in the matrix, in the minable areas. The content of the bone phosphate of lime varies from sixty-six to eighty per cent, which is determined by chemical analysis. There are three grades. From sixty-six to seventy per cent B.P.L. is known as low grade pebble. From seventy to seventy-four per cent B.P.L. middle or medium grade pebble. From seventy-four to eighty per cent B.P.L. high grade pebble. In nearly all cases these different grades, which vary slightly, are mined and handled se-

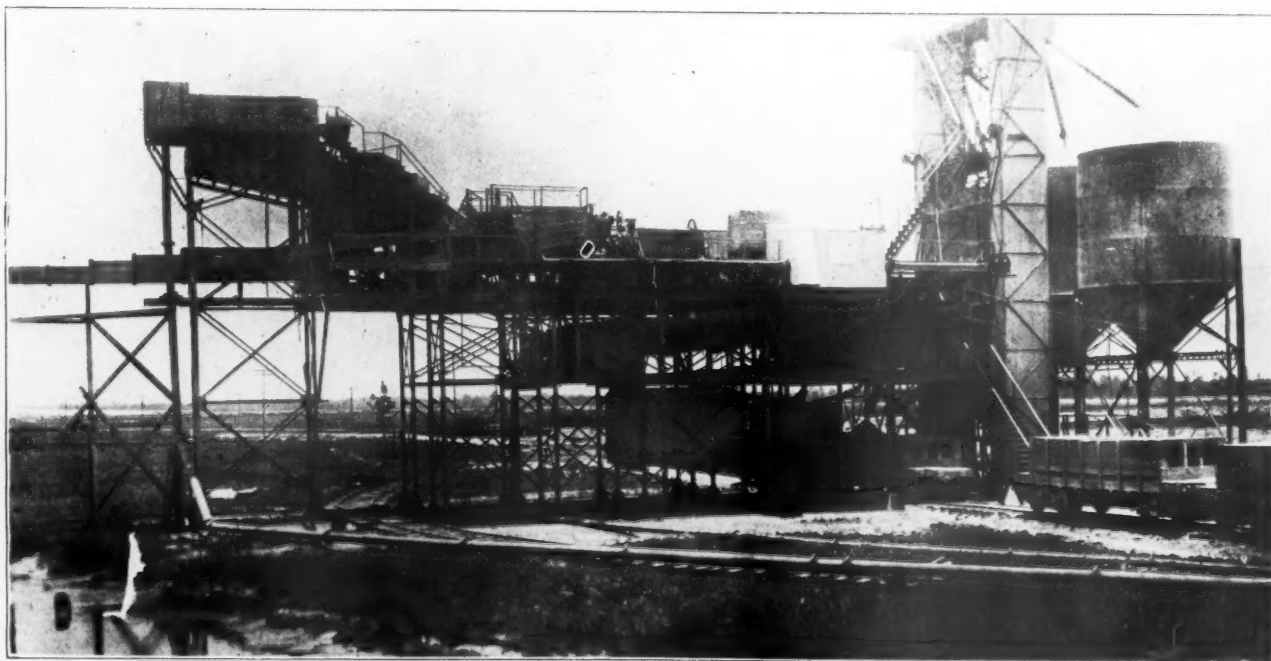
parately, as there is a considerable variation in price.

The mining of land pebble phosphate requires a very extensive outlay, which consists of mechanical, civil, electrical and chemical engineering equipment and the operation of electrical power stations, railroads, machine shops, and washing and drying plants. The most up-to-date machinery is employed, which entails the expenditure of large sums of money. The majority of the plants are surrounded by well kept villages where the employees and their families reside.

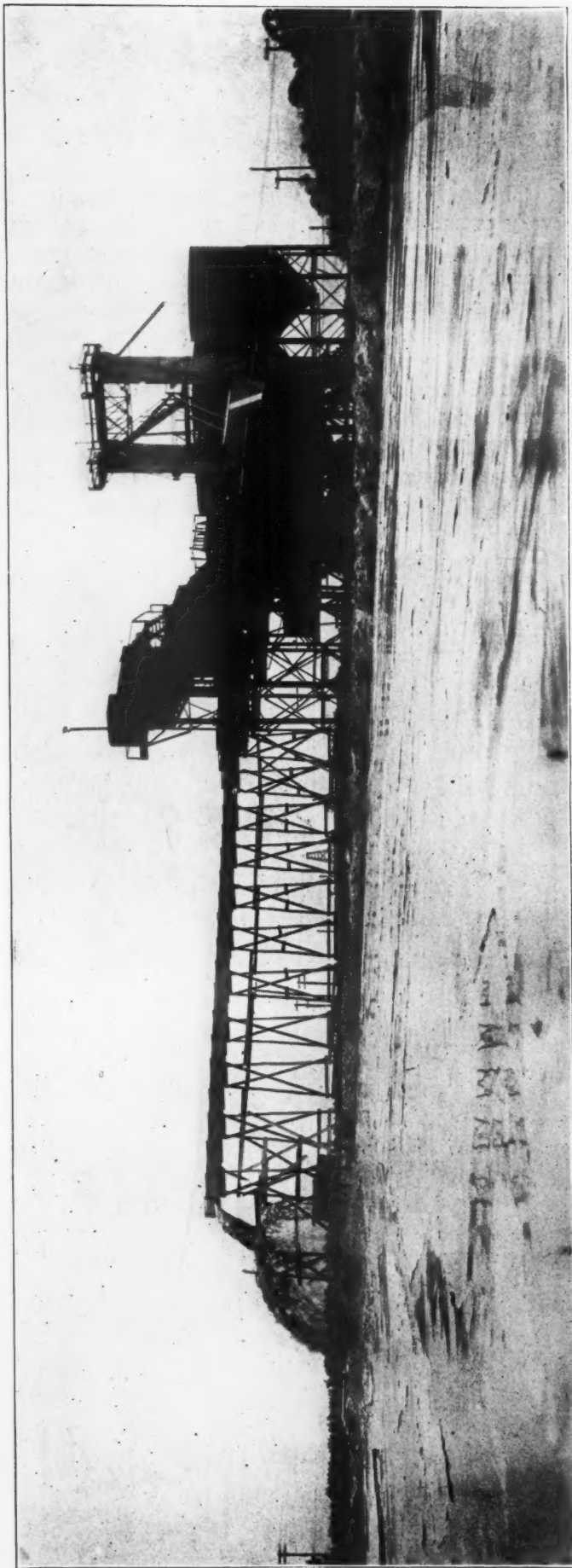
The mining operations consist entirely of open pit work. In most cases hydraulic sluicing is em-



Overburden Pit in Operation



General View of Screening and Storage Plant



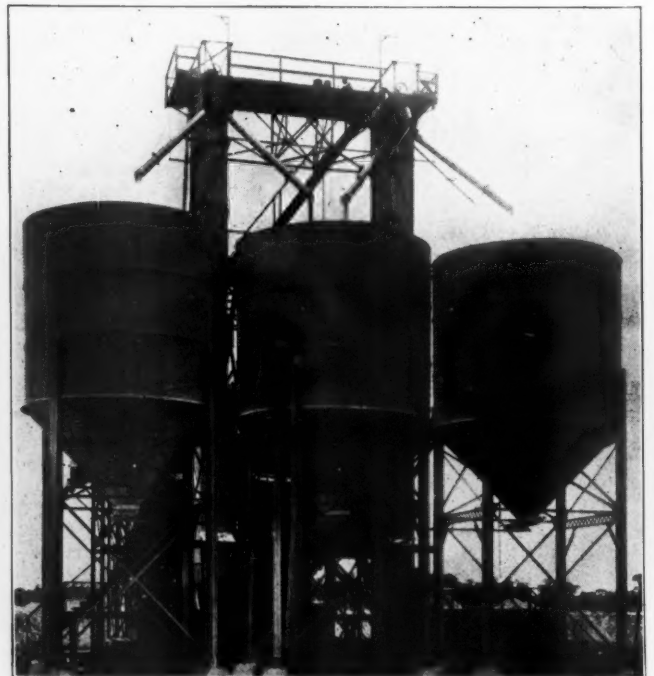
View Showing Method of Returning Waste



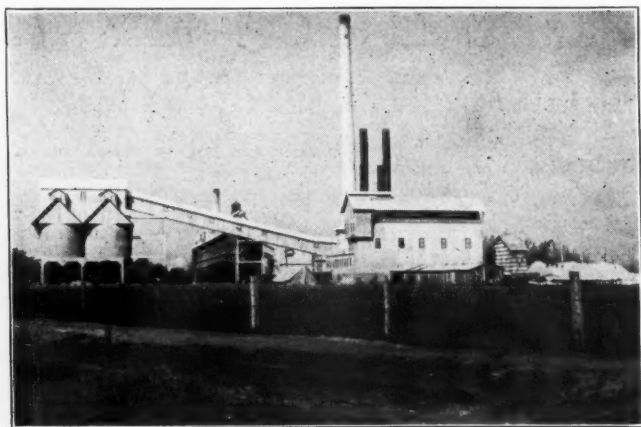
View of Hydraulic Sluicing Operation

ployed in handling both the matrix and overburden. This is done with hand operated hydraulic monitors, which shoot cutting streams, two inches in diameter, into the bank, cutting it down and tearing it apart. These monitors are furnished with water through pipe lines, by pumps which operate against a head of about five hundred feet, and produce over two hundred pounds of pressure to the square inch. The water and matrix are drifted through ditches to a sump hole where a heavy duty sand pump picks them up and discharges them up to a washer, where the material is thoroughly washed, scrubbed, rinsed, screened and elevated into storage bins.

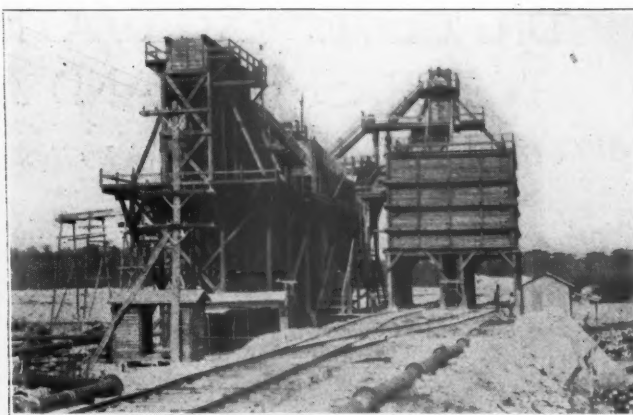
The new type washers are built of steel and have a capacity of as high as one hundred tons of washed rock per hour. These washers are composed of separators, flat screens, vibrating screens, rotary screens and logs. The washer is generally built in a location where a large area can be mined around it, and sometimes material is pumped con-



Close-Up of the Tanks



Drying Plant and Dry Bins



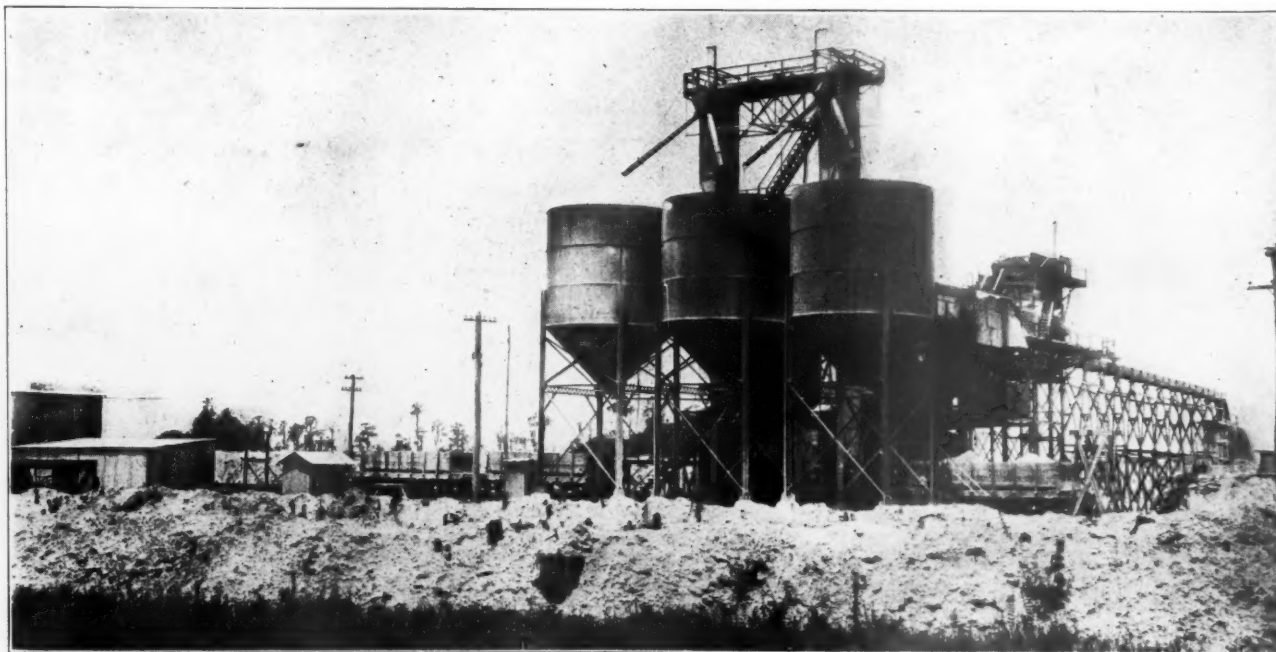
Pebble Phosphate Washer

siderably over a half mile to it. In this case three heavy duty sand pumps are generally employed to handle the material. The amount, material handled by these pumps varies from one hundred and fifty to two hundred and fifty cubic yards per hour.

The debris from the washer, as well as the overburden, is piled out on waste dumps, and the water from these is circulated around through a system of dams and mined out pits, in order to clarify it. After it has traveled through the circulating system it returns to the pressure pumps practically clear, and is used over and over again. In some cases where the elevation is not sufficient, drag-lines are used for constructing dams, in order to force the water back by gravity. In other cases low head pumps are used for lifting the water from one elevation to another in the circulating systems. The original supply of water is furnished from deep wells which continue to operate at intervals, in order to replace the amount of water lost from evaporation, seepage, etc.

In some cases the plant and mines are from eight to twelve miles apart, and it is necessary to construct high tension electric lines and railroads. The rock is hauled from the washers to the plants, in steel dump cars, where it is dried and stored in bins awaiting shipment to all parts of the world. Most of it is loaded into tramp steamers at Tampa. The majority of land pebble phosphate rock is used in the manufacture of fertilizers. Smaller portions are used in the manufacture of chemicals, matches, baking powder, phosphorus, etc. It leaves the mines in the raw state, and has to be finely ground and treated chemically before it can be used for any of the above purposes.

There is a great deal of prehistoric value attached to the mining of land pebble phosphate, in view of the fact that a great many skeletons and bones, of both land and marine animals, are found embedded in the matrix. Huge mastodon jaw bones and teeth, leg and rib bones, as well as huge manatee skeletons and sharks' teeth as large as a man's hand are frequently mined up.



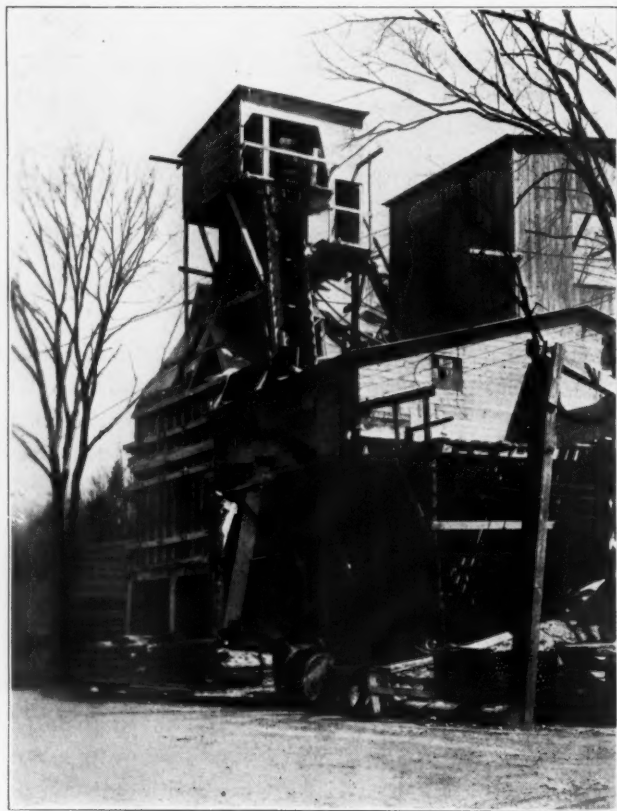
The Tanks With Plant in Rear

DRAGLINE EXCAVATION USED EFFECTIVELY BY BERKSHIRE SAND AND GRAVEL COMPANY

By George Ransom

OPERATING an inland sand and gravel deposit where the material lies in a high, dry ridge but which has an unlimited supply of water right at its door at all seasons for washing purposes may not be a curiosity but it is certainly a blessing to its owners. The Berkshire Sand and Gravel Company, of Lenox Dale, Massachusetts, produces under conditions as here described, the plant being located on the east bank of the Housatonic River. The plant was started about ten years ago by two young engineers, A. J. Newton and J. W. Washburn, not long out of college, and there is ample evidence in the appearance of the plant of the value of a technical education when applied in a practical manner. The premises are neat, the processes are well laid out, the equipment is kept in good condition and there are some unusually interesting features, especially in the use of drag line scrapers.

The property comprises about 100 acres and includes a long high ridge along the bank of the river. This ridge is largely sand and gravel and requires very little stripping. Material is obtained by a 2 yard Sauerman drag line scraper, running out about 650 feet and capable of bringing in three tons every two minutes. The material is dragged from the bank of a hill to the main hopper. When



The Crushing Plant



Two Yard Scraper Working in Pit

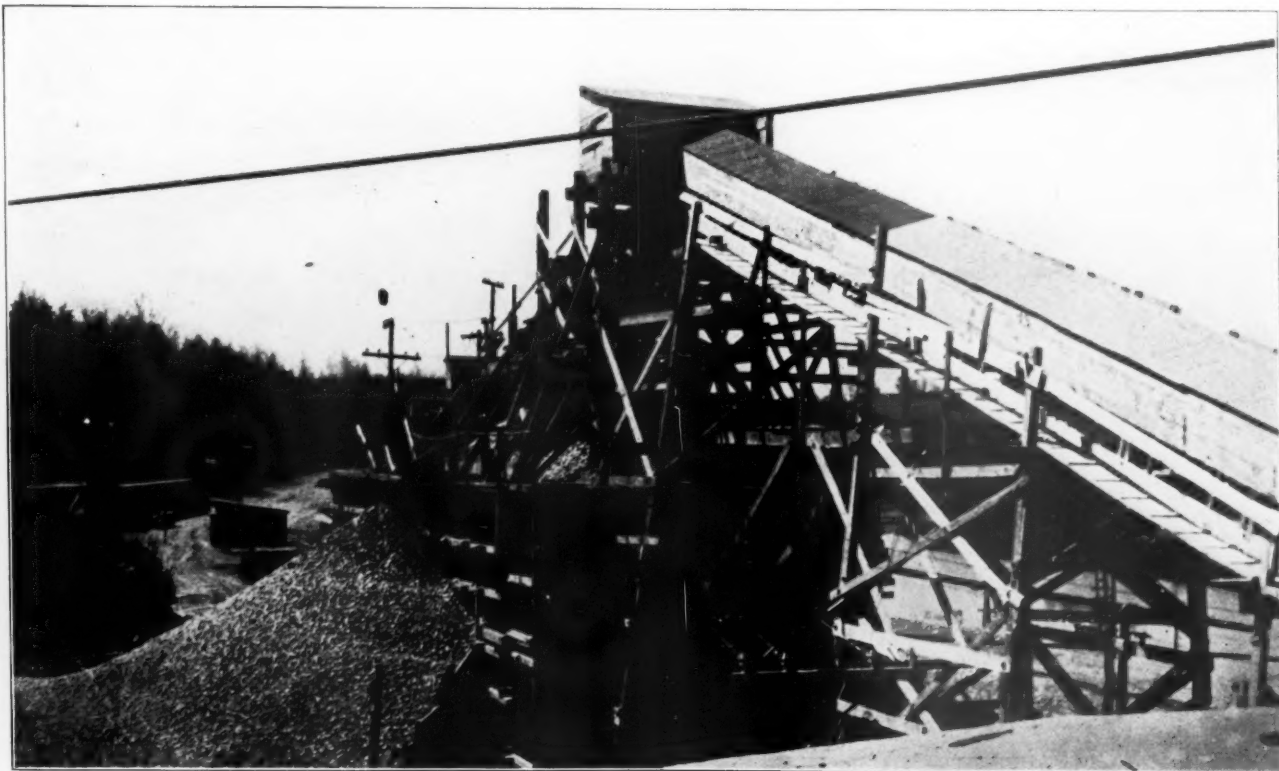


Small Scraper Filling Sand Loading Bins

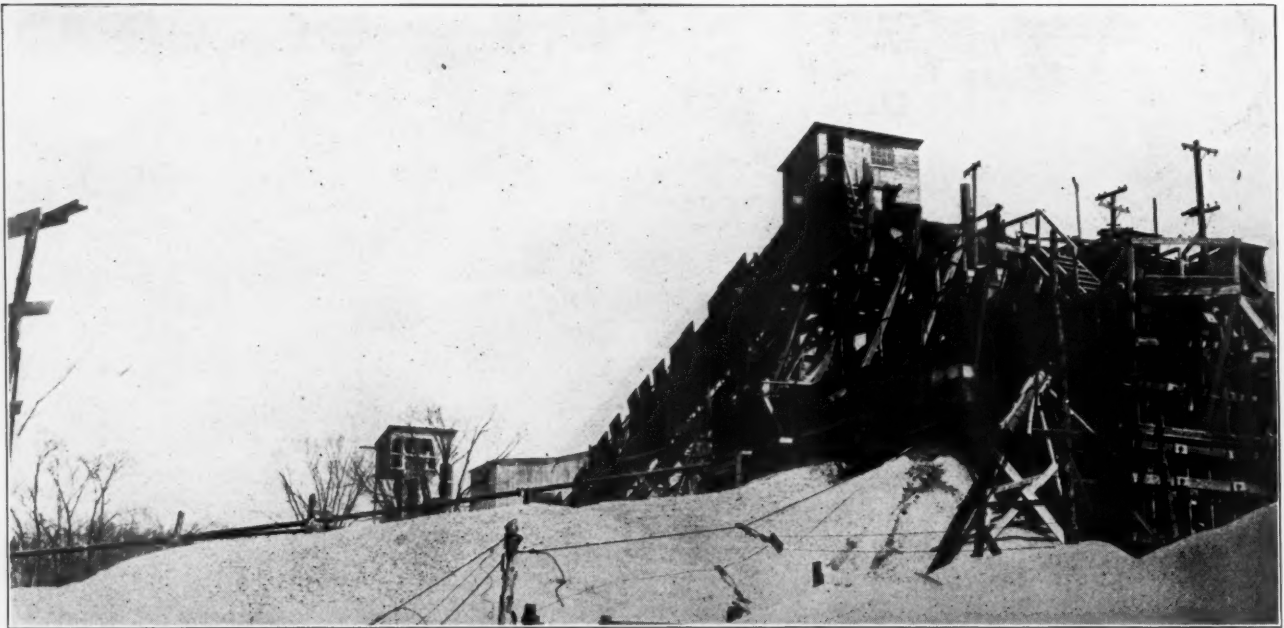
the digging is exceptionally hard a Sauerman 1 yard excavator bucket is used. Railroad rails are placed on top of the hopper to keep out stone over 14 inches in diameter. The stone thus rejected is broken with stone hammers.

From the grizzly the sand, gravel and stone drop into a 36 inch cylindrical rotary scalping screen which separates everything of two inches and

under and deposits it on a 24 inch Link-Belt conveyor, 160 feet between centers. This conveyor delivers to the washing plant, which is separate from the crushed stone plant. The oversizes from the scalping screen drop to two jaw crushers, 14x28 and 11x22 in size, arranged so that the overflow from the larger is taken by the smaller. The stone is taken from the crushers by bucket eleva-



Conveyor Loading Up to Washing Plant



General View of Plant, Washing in Foreground, Crushing in Background

tors of 50 foot centers to a cylindrical sizing screen with $\frac{1}{4}$, $\frac{5}{8}$ and $2\frac{1}{2}$ inch openings. All oversize material from this screen drops to a short belt conveyor which carries it back to the crushers. The crushed stone storage bins have a capacity of 400 tons and are equipped with single acting discharge gates. The bins are of concrete construction and have a double driveway underneath. All of this equipment has been supplied by the New England Road Machinery Company and is concentrated close to the grizzly end of the scraper.

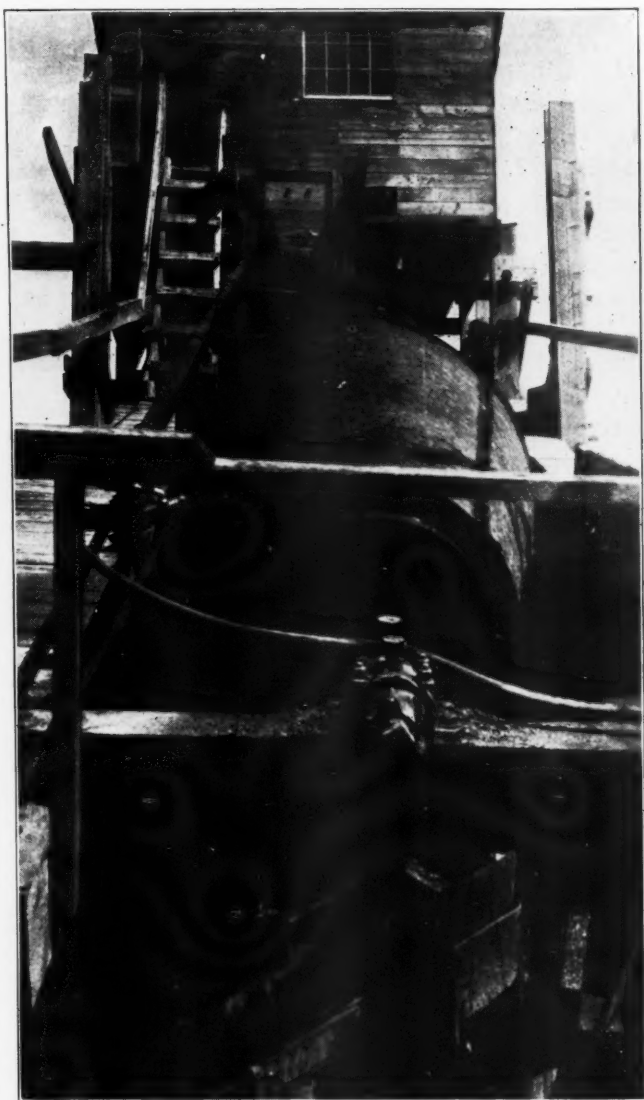
The screening and washing plant for sand and gravel is located a short distance away from the crushing plant. It consists of a series of Dull con-

ical screens with a Link-Belt vibrating screen under the last section to remove grit from the roofing gravel. These materials are deposited in bins for convenience in loading but at times there are large piles of surplus. Stone of $\frac{1}{2}$, 1 and 2 inch is graded at this end of the plant. The screened stone storage bins are also of concrete construction and they have a capacity of 1,500 tons. Duplex gates are used for all sizes except one where a Blaw-Knox batcher is used to load the stone mixed for batch loading.

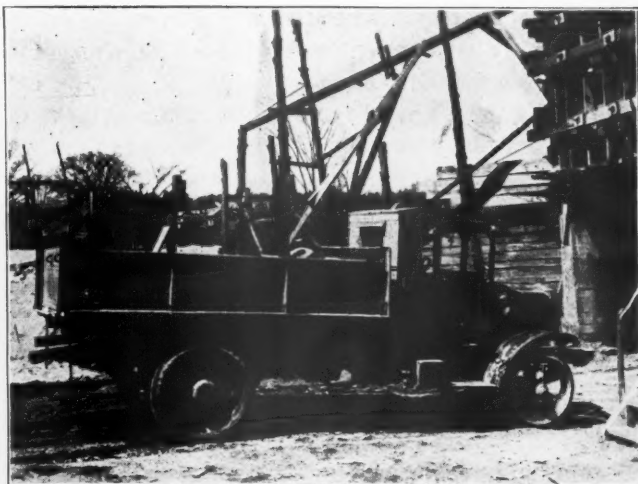
Two Link-Belt sand separators are used to handle the sand. One separator gives plastering and brick sand and the other concrete sand. The se-



Individual Garages at Right. Office at Left. Plant Is in Background



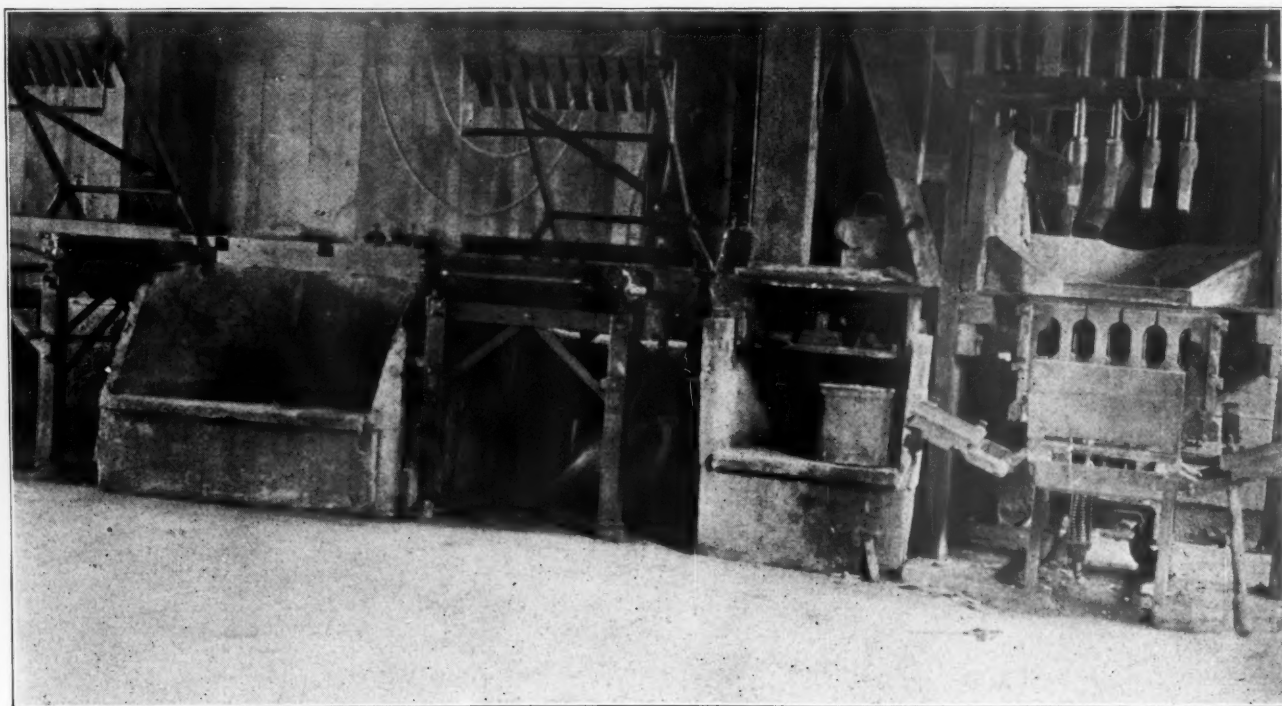
Conical Washing Screen



Truck Entering Under Loading Bins

parators are located on towers and the sand flows to the ground where the water runs off. The sand is then picked up by a $\frac{1}{4}$ yard Sauerman crescent type bucket and delivered to a hopper. This method does away with sloppy sand and permits large storage. A Blaw-Knox batcher is used as a discharge gate in the loading hopper. This permits batch loading of sand when necessary. Another Blaw-Knox batcher in the loading hopper feeds the mixer in the Shope brick plant. Stock piles of various sizes and grades are conveniently located about the plant. This storage is in addition to the bin storage. Trucks are loaded from these stock piles by a Nelson one-man batcher.

Water is supplied to the washing plant by a 500 gallon per minute Worthington centrifugal pump driven by a General Electric induction motor. The waste dirty water is pumped back to a swamp about 1000 feet away by a Gould pump



Block Machines at Right. Brick Machines at Left

of similar capacity. The distance which the clean water has to be pumped is very short, as the plant is on the edge of the river.

There is a third Sauerman scraper which is moved from place to place to make up storage piles. The hoisting engine and motor are placed on a truck which is anchored at any desired location about the plant. Five electrical plug-in outlets have been provided, from which the motor is supplied with power. Such an arrangement as this gives sufficient flexibility of movement and very nicely solves the problem of handling surplus materials at this plant at low cost.

The entire plant is electrically operated. One 75 H.P. motor drives the Sauerman hoist for bringing in the material. One 75 H.P. motor operates the two crushers, automatic feed and the scalping screen. One 20 H.P. motor operates the bucket elevator and the crushed stone screens. One 20 H.P. motor operates the belt conveyor and the conical screen, one 20 H.P. motor drives the Worthington pump and one 20 H.P. motor operates the $\frac{1}{4}$ yard Sauerman drag line handling the sand.

The maximum production of the plant is 1000 tons per day with six men, the average being 800-900 tons. Deliveries are made by the Company's six 5-ton White trucks equipped with dumps, and some contractors furnish their own trucks.

In addition to the crushed stone, sand and gravel operations, there is a cement block and brick plant. It is equipped with a Blystone mixer, a block machine and three brick machines of the same make. The brick machines are capable of turning out 4000 bricks each per day and the block machine about 600 blocks. The men necessary to operate this plant are as follows: Two men at the mixer, two men on the block machine and one man at each of the brick machines.

Advantages of Arc Welding

In a paper contributed by the machine shop practice division and presented at the spring meeting, White Sulphur Springs, West Virginia, May 23-26, 1927, of the American Society of Mechanical Engineers, J. F. Lincoln, vice-president of the Lincoln Electric Company, pointed out that, as compared to riveting, arc-welded steel will give the full strength of the joint, while rivets will give but 50 to 80 per cent of the sheet strength when the riveted joint is made in the usual commercial manner. This means that any structure which is made of riveted steel and depends on the strength of the joint for its efficiency must have from 30 to 100 per cent more steel in it than would be necessary were an arc-welded joint used.

However, he says, there is still another application which is of very much greater importance, namely, the employment of arc-welded steel in place of castings of all kinds.

Cast iron has a tensile strength of approximately 10,000 lb. per sq. in.; that of welded steel is approximately 50,000 lb. Cast iron has a modulus of elasticity of 12,000,000; that of steel is 30,000,000. Castings on an average cost 6 cents per lb.; rolled steel, 2 cents.

The factor of safety necessary for the same degree of safety will be half as great with steel as with cast iron. Therefore, if a pressure vessel in which the strength of the steel is the limiting factor is made from cast iron, it will cost for the same degree of safety approximately twenty-five times as much as if made from rolled steel; if a base or any structure which is used for resisting bending is to be made, the cost will be but approximately 15 per cent as much if made from structural steel as if made from castings.



Exterior View of Brick Plant and Storage Yard

SYNTHETIC MOLDING SANDS IN THE MALLEABLE FOUNDRY

By F. C. Scheiber,
Superintendent, Malleable and Alloy Foundries, General Electric Company*

DURING the past five years more research work has been done towards improving molding sand for the foundry than in all of its whole past history. The foundrymen are realizing that most of their difficulties and problems are in the make-up and structure of nature's sands, and are not wholly due to oxides in the molten metal caused by poor quality of pig iron and rusty scrap.

Molding sand has been a bugbear for the foundrymen ever since the first casting was cast in sand. Sand wastes were enormous in order to keep their sand piles, as they believed, in first class condition. We think the molders of the past generation did very well. But then again they had plenty of time to take care of their sand, which was a large part of their job. Production was slow, sand was cheap and they had plenty of time for preparing it. But, as years advanced, times changed, production increased, good uniform sand was impossible to get. The molder now had little time for pondering over sand conditioning, with the result that this conditioning has been given over to foundry laborers.

The old molders died off, with them went the reliably kept sand pile and for years we have depended on inexperienced labor to make and blend our raw molding sand into a workable heap for the foundry. That this has been a complete failure some foundrymen will not admit, but it is nevertheless the case. Thousands of dollars have been thrown in the scrap heap on account of poor molding sand. Our good and intelligent molders and apprentices have been driven from our foundries on account of having to stand the losses of castings due to sand conditions. New surface sands full of organic matter cannot be transferred from the sand bank and dumped on our molding floor with expectations of making good castings.

We read an interesting article in the Industry Illustrated Magazine by Francis Juraschek, from which we quote as follows:

"Stop building concrete walls inside your boilers. Why feed water treatment pays." This article goes on to say, "Water is H_2O , says the chemist, and that is a correct definition, if you mean pure water. But where will you find pure water in Nature? Water from rivers, from lakes, from springs and from wells, is far from pure. In a

100 h.p. boiler evaporating 400 gallons of water per hour, water with only 15 grains of scale forming minerals per U. S. gallon will deposit 20.6 pounds of scale in 24 hours."

It would be suicide to feed unfiltered water to our boilers, and so it is the same with molding sand and our foundries. Surface sand from natural deposits may be likened to unfiltered water, and is not good for foundry use before treatment.

Sands Should Be Treated Before Using

After years of experimentation and many failures, the writer has come to the conclusion that all molding sand should be treated before being used. Molding sand in its natural state is saturated with foreign matter and flame producing elements which if not removed before molding will cause blows, washes, cracks, rough spots, cuts, scabs, blisters, excess shrinkage, and prevent the free escape of gases.

The greatest waste in a foundry is discarded sand, which after once being used is thrown out on the dump at a cost of \$2.00 per ton to carry it out of the foundry. Along with it goes iron scrap of good value. If we can only reclaim the value of this material which is now classed as refuse, by running it through a reviving system, we have for a base a sand free of all foreign matter which will produce, if treated rightly, a better sand for all classes of molding than when it was in the green state. Some foundries make a practice of putting this sand back in the sand heap without cleaning. This should not be done, as the silt in it causes the sand pile to decrease in permeability, which lack of permeability in the sand causes an increase in defective castings.

Old Core Sand Makes Excellent Base for Molding Sand

Take the burnt out molding sand which clings to the hot castings on the shake out and the used core butts and old cores which are hooked out of the sand after pouring and run this material through a cleaning process. Can you get any better sand as a base than old core sand with its perfect round grains which prevent interlocking when rammed in the mold, thereby guaranteeing a free vent for the escape of gases?

Is there a cleaner sand to be found for molding purposes than this sand high in silica content? Yet, this sand was formerly thrown on the dump.

*Paper presented before the American Foundrymen's Association, June 8, 1927.

You can take this valuable sand after cleaning and blend it with your discarded molding sand and make any kind of a new molding sand you need for medium, light or heavy work. And it will be a sand a molder can depend on. It also will be one which will cut your foundry defectives to a minimum.

For the past two and a half years we have been using nothing but prepared sand in our malleable foundry at Erie, Pa., and the results have proven very satisfactory. Our losses have decreased beyond expectation. Our molders are highly pleased with the conditions and when your molders are pleased it is half of the battle. The appearance and surface of our castings have improved and molding conditions in general are greatly improved.

Treating Core Sands for Molding

Treating core sands for molding purposes is a simple process, provided the sands are put in shape for such treatment. For instance, the sands used should be of uniform size, round and of good sound structure such as Ottawa or Michigan drift sands. The sand can be used first for cores, and after casting, all core butts, scrap cores, core room sweepings and discarded sands should be run through a barrel type furnace with heat high enough to burn out all core binder and water crystals on the surface of each grain in order to make the surface clean and rough to hold the clay bath. The heat should be high enough to break down all cores without a grinding operation, as grinding destroys the round sand grains and makes sharp grains which are a detriment to a good molding sand.

All sands should be screened in the dry state and scrap removed, and all excess dust and silt should be eliminated by air separation before mixing. By doing this we remove 90 per cent of our molding sand troubles. A mixing machine of a large enough capacity should be used for mixing the molding sand to give it the required blending, or, in other words, distribute the clay evenly around each grain of sand without breaking up the sand grain structures. This operation is important to get good results, for where we substitute a grinder or any other kind of method to do this work it will prove a failure.

The proper clay to use for the bonding purposes in molding sands is a problem and should be given much thought and study; for on the clay used hinges the success of this process. First, we should use a clay with high heat resisting qualities and containing over 60 per cent of colloids. For good molding sands depend not only upon the colloidal content in the clay, but on the extent to which this content is held under various conditions of heat.

The clays used should be pulverized to a fineness of 40-mesh or better, and made into an emulsion

bath and have this bath worked in such a manner that the disruption and dispersion are so complete that all are changed into a colloidal mist. Dry clay should never be added to the sand heap, for it is impossible to distribute it evenly over the pile and coat each grain of sand with the desired amount of clay without forming clay balls and clay pockets which are detrimental to good foundry practice.

For a long time the writer has had difficulty with the sand drying out too quickly both in the pile and in the molds. This was found to be true in large molds where the drag and cope were exposed a long time before closing, and the molder had trouble in slicking and patching on account of this dryness. This difficulty was corrected by the use of a small amount of glycerine in the emulsion bath. This is something new in the foundry industry and will keep the sand moist for hours or days, according to the amount of glycerine used.

Great care should be used in the mixing process. The material should only be milled long enough for complete distribution. To the treated sand is added enough coal dust to produce a mild smudge when coming in contact with the molten iron. This insures a smooth casting easily cleaned. A small part of corn flour for green bond should then be placed in the mill and milled for two minutes; to this mixture then the clay-glycerine emulsion bath is added and again milled for three minutes. This newly prepared sand should then be riddled to give a light, fluffy and well aerated product before beginning the molding operations, and this sand should be used in making the entire mold.

Molding sand prepared in this manner is free venting sand with sufficient outlet for the steam and air generated by the molten iron entering the mold, which guarantees a good sound casting. It is a great mistake for foundries to use a good facing sand of a fraction of an inch in depth next to the pattern and back this up with old heap sand full of silt and expect a good casting.

A good grade of molding sand made as described can be used for all classes of work and will produce good sound castings with a better surface than a mixture of several grades of natural sand. The reason for this is that the sand grains are all uniform and can be rammed to the surface of the pattern, which produces a smooth surface and clean pattern draw. This method will fit in very nicely where foundries have sand conveying systems.

We believe the time is at hand for the foundries to install their own sand handling and sand treating machinery to insure a good reliable product. A product which will produce good castings free of blemishes, which in turn automatically increases production and makes use of good materials formerly thrown on the dump. All of this means a great saving in money and fewer worries for the foundry superintendent.

CLINKER COMPOSITION AND CONTROL OF RAW CEMENT MIXTURES

By K. Tremmel*

CONSTITUTION of Portland cement clinker has been thoroughly investigated by W. Dyckerhoff. He followed the American cement chemists Rankin, Shepherd and Wright in their basic studies on this subject. The investigations of these chemists and those of Dyckerhoff did not yield conclusions which agreed. The American chemists hold that the main components of the clinker are 3CaOSiO_2 , 2CaOSiO_2 , $3\text{CaOAl}_2\text{O}_3$, or CaO , 3CaOSiO_2 , $3\text{CaOAl}_2\text{O}_3$, according to the variation in the lime content. The hardening of the cement is effected by the hydration of the calcium silicate, and principally by the tricalcium silicate, which is alite.

In the ideal super-clinker it is therefore necessary that all of the silica is combined in the form of tricalcium silicate. A greater amount of lime than necessary for the combination of this silicate would be free and cause efflorescence of lime.

Dyckerhoff on the other hand says: "At the normal burning temperature of Portland cement clinker, 3CaOSiO_2 is not formed, or only at a low speed, and this first becomes considerable at a temperature of approximately 1600 degrees C. Tricalcium silicate can be found only in very hard burnt cement or in the molten clinker and then in small amounts. In addition to $3\text{CaOAl}_2\text{O}_3$ only the bicalcium silicate is present in normal clinker, and the silicate has the power of holding lime in solid solution and is then identical with alite. The solubility of the lime is approximately half a molecule. Any lime present in the mixture in excess of this amount is set free."

The question arises as to which of these theories is the correct one. Both have their supporters both in America and in Germany. It is however not without importance for the cement manufacturer to know which of these is the correct one, for very important conclusions can then be drawn with respect to the proper composition of the raw cement mixture.

The reason for this is as follows. The hardening of cement depends on the hydration of the calcium silicate. The other components, calcium aluminate, calcium ferrite, etc., which facilitate the sintering operations acting as fluxes, do not play any role in this connection or only one of secondary importance. The greater the proportion of lime in the silicate, the more reactive it will be. On the other hand an excess of lime should be avoided, for this will result in a lower grade cement.

The raw cement mixture, particularly in the case of super-cements, must be proportioned in such a

manner that in addition to the presence of a minimum of flux, which is required for sintering, the lime content must be just sufficient for the formation of the silicate most rich in lime, on the natural assumption that all the components can react with each other in the desired manner.

In accordance with the American theory on this subject the ratio of silica to lime must be within the limits of one to three (the lime in this case being that available after formation of the flux and the ratio referring to moles), while this same ratio is only one to two and a half according to Dyckerhoff. It thus is evident that the first ratio would represent a considerable excess of lime if the Dyckerhoff ratio was the correct one.

The work being described herein was undertaken for the purpose of clearing up this matter. There are two important questions. First, do the limits of the ideally prepared normally sintered Portland cement clinker lie at a molecular ratio of silica to lime, equal to 1:3, or lower? Second, in case the lower limits are shown to be correct, is it possible in this case to increase these limits by increasing the sintering temperature, or by melting the clinker, by the formation of tricalcium silicate, and in this manner increase still further the reactivity of the clinker?

While the work in question was carried out along optical-mineralogical lines for the most part in the attempt to identify the minerals present in the clinker, nevertheless a chemical method was also used, which depended on the determination of the "free lime." There are many methods that can be used for this purpose and they mostly depend on the action of ammonium salts in alcoholic solution or vapor form on the clinker, with exclusion of water, in order to prevent hydrolytic splitting of the lime hydrate from the silicate.

"Free lime" in the chemical mineralogical sense is that lime which is neither combined with acid in the clinker nor is dissolved in any medium, but is embedded in the clinker structure as an individual mineral in any of the forms that are common to CaO . A sure evidence of the presence of the "free lime" can be obtained from a microscopic-crystallographic investigation. It is understandingly not to be confused with the lime hydrate that is split off in the hydration of silicates.

"Free lime" from the standpoint of the cement maker, and this means from the chemical-technical standpoint, is that portion of the lime content of the clinker which is converted into lime hydrate during the hardening process with the phenomenon of

*Translated from Zement.

"dusting." The lime is thus made to separate on the surface of the cement.

This conception agrees with the chemical-mineralogical one, but it must not be assumed to possess the same significance as the latter. Not only the lime which is absolutely free in the form of mineral is included in this category, but also that portion of the lime which is so loosely combined or dissolved under certain conditions in any sort of compound that on hydration it results in the manifestation of the lime efflorescence phenomenon. This form of "free lime" can be detected through the commonly known methods of accelerated constancy of volume tests. However these tests are not accurate enough for highly scientific determinations and they require comparatively large amounts of testing sample. The most accurate tests are obtained with the Prussian compressed cakes and the Heinz ball incandescence test. There is also a very simple microchemical test for recognizing the form of the lime, which has been developed by White. It depends on the formation of calcium phenolate from the lime in the clinker and phenol, the reaction taking place in a solution of nitrobenzol. The reagent consists of a mixture of five grams of phenol, five grams of nitrobenzol and two drops of distilled water. The determination is carried out in such a manner that some of the substance which is to be examined for free lime cement is placed on the object carrier in a microscope, mixed with a little of the aforementioned reagent and examined through a crossed Nichols prism. If lime is present in the cement, then strong double-refractive needles of calcium phenolate are observed after a few minutes have elapsed.

In order to test the availability of the reagent, different preliminary tests were carried out with pure lime hydrate as well as blast furnace slag and Portland cement clinker.

1. The influence on lime as well as on lime hydrate was examined. In the case of freshly calcined lime the needles were immediately visible,

while in the case of lime hydrate they appeared approximately after seven minutes.

2. The influence on blast furnace slag and Portland cement clinker. These tests were carried out in such a fashion so as to determine the action of the lime compounds in the clinker and a comparison was made with one of the other more accurate methods for testing products for their free lime content, the Heintzel ball test. The results of these tests are given below in tabular form.

The following conclusions are obtained from the results that are shown in the above tabulation. In the first place the blast furnace slags as well as the clinker, whose lime content lies below the dusting limit, show no new formations.

In the case of clinker, which contains such a proportion of "free lime" that the dusting phenomenon ensues, the reaction took place within a period of three minutes at the very longest. The frequency with which new structure formations ensue can be used in arriving at a conclusion on the intensity of the tendency towards the efflorescence phenomenon. This test is more accurate than the ball test.

The rapidity with which new structures are formed is different with the various preparations. While in the case of the lime that was calcined at a temperature of 900 degrees C., the preliminary test showed that reaction took place immediately, in the case of clinker number VII, which contain lime that was only slightly calcined, the reaction took place after one and one half minutes and in the rest of the well-sintered clinker reaction set in within two and one half to three minutes. There is accordingly a difference in the appearance of the needles. When the crystalline structure is rapidly developed, all of the needles are coarsely crystalline, but when the rapidity of the development is slow, then they are very fine and intricately interlaced with one another. In fact so intricate is the structure that it is recognizable only through the property of high double refraction that it possesses.

Lime hydrate also enters into the reaction. This

TABULATION I

WITH THE HEINTZEL BALL TEST							
ACTION OF PHENOL-NITROBENZOL MIXTURE ON BLAST FURNACE SLAG AND CLINKER COMPARED							
Substance Tested	SiO ₂	R ₂ O ₃	CaO	First appearance of needles	Frequency of needles	Found after one hour	Result of the sphere test
Blast furnace slag I	36.00	16.10	43.00	.....	.....	.....	stable
Blast furnace slag II	31.50	15.20	48.20	.....	.....	.....	stable
Portland cement I	21.40	10.80	62.90	.....	.....	.....	stable
Portland cement II	21.30	10.40	63.50	.....	.....	.....	stable
Clinker I	20.30	10.40	63.70	.....	.....	.....	stable
Clinker II	22.00	8.20	64.30	.....	.....	.....	stable
Clinker III	19.00	9.80	65.50	3 minutes	very seldom	New formation increased	stable
Clinker IV	20.80	10.00	64.80	2.5 minutes	very seldom	New formation increased	stable
Clinker V	19.80	8.10	64.90	3 minutes	combined	New formation increased	not stable
Clinker VI	18.20	8.80	66.60	2.5 minutes	frequent	The new formations closed	Slight cracks
Clinker VII	19.30	8.70	65.80	1.5 minutes	frequent	up and fill	Not stable
Clinker VIII	19.30	9.20	67.10	2.5 minutes	frequent	the entire vision	Cone formation

reaction takes place at a much slower speed than in the case of lime, that is, it sets in after a period of seven minutes has elapsed. In order to avoid any uncertainty in the results and in their interpretation, it is recommended that only freshly prepared substance be used in the experiments, in which case the possibility is excluded that the lime hydrate is split off through hydration of the silicates.

After the availability of these methods for this investigation has been determined, it is possible to use them to determine the highest allowable proportion of lime in the clinker. The clinker, which is described in tabulation I is not suitable for this purpose, for the reason that in the first place a much greater fineness of grinding than usual is necessary in the neighborhood of the efflorescence limit, in order to obtain an accurate conclusion, and on the other hand because the action of the secondary ingredients of the clinker, such as iron oxide, magnesia and sulphur trioxide, has not yet been thoroughly explained. For this reason the following series of experiments were carried out.

Experiment Series No. 1. A series of clinkers, containing pure silica, alumina and calcium carbonate, were burnt. The composition was varied in such a manner that when the alumina remained approximately constant (in order to maintain the quantity of flux constant) the molecular ration silica to lime was changed from 1:2.4 to 1:3.0. The degree of calcination was varied in each of these clinkers from incipient sintering to complete fusion.

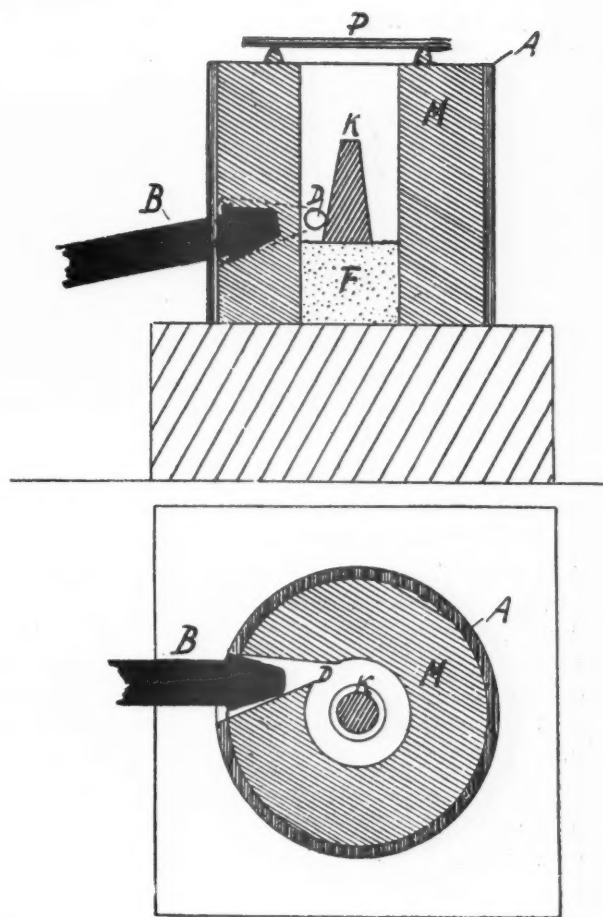
Experiment Series No. 2. The molten product of the two-substance system, iron oxide (Fe_2O_3)-lime, as well as of the three-substance system, iron oxide-lime and silica, were also prepared.

Experiment Series No. 3. The influence of magnesia on the dusting limit of clinker was also investigated.

All the clinkers that were used in making these experiments were examined both analytically and microscopically in the powder form, and the dusting limit was determined in accordance with the methods that have been described above.

The starting products were as follows: precipitated calcium carbonate by analysis, alumina by analysis, iron oxide (Fe_2O_3) by analysis and magnesia by analysis. All of these substances were screened through a 10,000 mesh screen. Ground standard sand was used as silica and this was ground so as to pass through a 10,000 mesh screen, then washed four times with concentrated hydrochloric acid.

The burning of the samples was accomplished in the following manner. The previously mixed crude cement mixture is rubbed into a paste with water on a plate with the aid of a spatula, in a manner similar to that used in mixing oil colors, and then the paste is formed into pyramid shapes just like Seger cones. These pyramids, after being dried, are heated in a furnace fired with the aid of oxy-



hydrogen gas. The furnace consists of a cylindrical sheet metal covering A (see accompanying figure), which contains a lining of aluminon mortar M, so that a combustion space of four centimeters diameter and ten centimeters height is formed. The burner nozzle is inserted tangentially to the combustion chamber and is seen at D, and the oxyhydrogen burner is inserted at B through this opening. The flame does not therefore come into direct contact with the material that is being heated. The flame travels in a spiral path and the clinker is thereby indirectly but uniformly heated. The clinker sample K is placed on a mass of pulverized alumina F in order to prevent its melting together. The cover of the furnace is an asbestos plate.

The burning can be carried out in such a manner by regulating the flame that one side of the cone-shaped sample, which lies next to the impact side of the flame, is almost molten and all degrees of burning from strong sintering to slight burning are obtained from the inside of the cone to the opposite side. The cone will therefore tend to bend over on one side just like the regular Seger cones. The burning can be carried out either in an oxidizing or reducing atmosphere. It is understandable that temperature determinations cannot very well be made in this process, for the reason that the temperature varies very greatly. This is however not too great a disadvantage, since the samples are designated according to the degree of

burning, just like in the case of the Seger cone, as molten, strongly sintered (rotary kiln burnt), normally sintered (shaft kiln burnt), etc.

The results obtained in the first series of tests are described below. The alumina content of the clinker was adjusted at approximately fifteen per cent. This corresponds to about forty per cent of $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, which serves as a flux in the sintering process. The comparatively high content of alumina is selected in order to compensate for the normally insufficient proportion of flux in the clinker so that the temperature is not allowed to rise too high. The results of the experiments are given in tabulation number II.

The interpretation of the results given in this tabulation is as follows: The clinker that is produced under normal sintering conditions with alite structure is as good as completely stable towards the reagent up to a molecular proportion of SiO_2 to CaO or 1:2.59.

The needles that are observed in the case of clinker 2 are of no significance. They are assigned to the aggregation of lime in spite of the care that was taken in mixing the crude cement mass. The dusting effect becomes marked in clinker number 4.

The results obtained in carrying out an investigation of the molten clinker are very surprising. Microscopic testing shows a needle-like or prismatic structure in a glassy ground with fine polarized particles, which decrease as the lime content increases. The composition of the clinker is such that the formula $8\text{CaO} \cdot 2\text{SiO}_2 \cdot \text{Al}_2\text{O}_3$ is closely approached, the conclusion being that the greater part of the clinker is thus composed.

The results shown in tabulation II can be thus summarized. First, in the case of normally sintered Portland cement clinker the extreme dusting limit lies at a molecular ratio of silica to lime of 1:2.65, a result which agrees with the Dyckerhoff alite theory. In the second place, in spite of the fact that other compounds are formed during the

melting of the clinker, the dusting limit remains. Either no tricalcium silicate is formed under the comparatively rapid melting and heating (as is possible in the rotary kiln), or this compound also has dusting properties. The preparation of a clinker which is still more reactive in melting must therefore not be possible.

As far as the results of the second series of tests are concerned, it was noted at first that there are various differences in opinion on the combinations of iron oxide and lime. A series of melting tests on lime and iron oxide were carried out and the results showed that all the lime iron oxide compounds which contain less than two molecules of lime per molecule of iron oxide are resistant to the reagent. Any lime that is present in excess of this amount will appear as free lime. It is thus possible that the lime combination of iron oxide is limited to two molecules of lime in the Portland cement clinker.

Based on these results the dusting limit in the three substance system silica, lime and iron oxide was determined. It was found that it was not different from that which pertains to the three substance system lime, silica and alumina. The clinker was also melted and the proportion of flux chosen high so that good disintegration is obtained. The content of iron oxide in the clinker amounted to thirty per cent, so that fifty per cent of dicalcium ferrite must be formed from it. The remaining fifty per cent consists of lime and silica.

Microscopic testing of the powders gave the same results in all cases. The coarse particles were completely opaque, and appeared in yellowish-brownish translucence at the most around the edges. The finest splinters were partially yellowish brown and partially colorless and hence double refractive just as alite. Needle-like or prismatic crystals were not observed. The results of experiment showed, nevertheless, an abnormal composition, for at a molecular ratio of silica to lime of somewhat over 1:2.60 free lime appeared.

TABULATION II

Clinker No.	Analysis			$\text{SiO}_2:\text{Al}_2\text{O}_3$	Microscopic appearance	Effect of reagent	Microscopic appearance of molten clinker	Effect of reagent
	SiO_2	Al_2O_3	CaO					
I	18.40	14.30	66.80	1:2.52	alite structure with large crystals	none	prismatic crystals in glassy ground	none
II	18.00	14.25	66.95	1:2.59	ditto	none	none	ditto
III	17.56	14.46	67.46	1:2.67	alite structure fine	new formations after 2 minutes	ditto	after 2 minutes needles very fine
IV	17.10	15.00	67.50	1:2.69	ditto	same as before only stronger	same as before, less glassy ground as before	needle formation large
V	17.00	14.45	68.30	1:2.80	fine alite structure, fine particles with double refraction	considerable formation of needles		ditto
VI	16.90	14.80	68.05	1:2.87	ditto	ditto	ditto	ditto
VII	16.20	15.00	69.30	1:2.96	ditto	ditto	ditto	ditto

In the third series of tests the preliminary experiment consisted in heating magnesia to 1000 degrees C. as well as to approximately 1500 degrees C. and then the sample was tested under the microscope with the lime reagent. No reaction was observed.

Clinker number 2 of tabulation number II was mixed with five per cent of magnesia and sintered and molten products were obtained from it. In no case did reaction take place with the lime reagent. Hence the magnesia has not been able to supplant the lime in its compounds and is contained as free lime in the clinker.

This explains the different behavior of magnesia in blast furnace slag and in clinker. Magnesia is a substitute for lime in slag, and is combined with silica or alumina. Hydration does not affect the magnesium silicate or aluminate. On the other hand magnesia is present in the free, strongly sintered (dead-burnt) condition in clinker, so that at first it likewise does not react with water. The magnesia is nevertheless likewise hydrated after a longer time, resulting in a considerable swelling, which takes place rapidly in the case of the weakly burnt magnesite. If the magnesia content is greater than a certain maximum, then the swelling will cause destruction of the cement structure and the feared phenomenon of magnesia efflorescence makes its appearance.

A technical Portland cement clinker was melted both in an oxidizing and a reducing atmosphere. The analysis of the molten clinker was silica 20.80 percent, alumina 7.32 percent, iron oxide 4.45 percent, lime 64.50 percent and magnesia 3.10 percent. A trace of sulphur was also present, which need not be taken into consideration in this calculation. The analytical composition of the reducing-melted clinker is different from the clinker that was melted under oxidizing conditions only in that the state of oxidation of iron, that is as ferrous oxide or as metallic iron, varies. The molecular ratio of silica to lime is calculated in the case of the oxidizing melted clinker in the following manner.

7.32 grams of alumina require $1.65 \times 7.32 = 12.1$ grams of lime for the formation of tricalcium aluminate. 4.45 grams of iron oxide require $0.7 \times 4.45 = 3.12$ grams of lime for the formation of dicalcium ferrite. There thus remain 64.50 less 12.1 less 3.12 or 49.28 grams of lime and 20.80 grams of silica. 20.80 grams of silica are equal to 0.345 molecule of silica and 49.28 grams of lime are equal to 0.878 molecule of lime. The molecular ratio there is 0.345:0.878 or 1:2.54.

In the second case, that is, the reducing melted clinker, 3.12 percent of lime more are available for combination with silica due to the reason that FeO does not combine with lime. The silica-lime ratio is accordingly $20.80:52.40 = 0.345$ mole: 0.935 mole = 1:2.70. In the ratio of 1:2.54 the

clinker must not contain any free lime. At a ratio of 1:2.70 the efflorescence limit must be overstepped. Microscopic examination corroborates this contention. While the oxidizing molten clinker does not indicate any reaction with the reagent after a period of two hours, in the case of the reducing molten clinker a great number of calcium phenolate needles are seen distributed over the entire field of vision within a short time.

A further component of technical clinker that must be taken into consideration is the sulphur content, which element is present in the form of sulphate or sulphide. There is scarcely any doubt that sulphur is present in the clinker combined with an equivalent amount of lime in the form of calcium sulphate or calcium sulphide.

A numerical formula has been derived for the allowable limit and this is as follows:

$$\frac{1.07 \times \text{CaO} - (1.65 \cdot \text{Al}_2\text{O}_3 + 0.7 \cdot \text{Fe}_2\text{O}_3 + 0.7 \cdot \text{So}_3)}{\text{SiO}_2} = 2.65$$

This formula indicates that under conditions of best preparation of the raw cement mixture and best burning, the silica will absorb at a maximum 2.65 molecules of lime. Hence any lime that is present in excess of this amount will cause efflorescence. In order to obtain a clinker which is of the optimum quality, the raw cement mixture must be proportioned in such a manner that this limit is approached as close as possible but nevertheless not overstepped. Just how close it is possible to approach to this limit depends on the quality of the raw materials, their preparation and the like. The more unfavorable these factors are, the smaller will the value of the silica-lime ratio be at which efflorescence sets in. This value is easily determined in a series of tests with the help of the furnace which has been described above and the lime reagent as well.

In these experiments a clinker which has the following composition, namely, 21.40 percent of silica, 6.84 percent of alumina, 3.48 percent of iron oxide, 54.10 percent of lime, 2.20 percent of magnesia and 1.67 percent of sulphur trioxide, attained the efflorescence limit. By inserting the analytical values into the lime formula the efflorescence limit is given at this silica-lime ratio of 1:2.46. If the value 2.46 is divided by 2.65, then the figure 0.928 is obtained, which is known as the degree of decomposition. It indicates that under the given conditions the silica in the clinker absorbs 0.928 part or 92.8 percent of the theoretical maximum amount of lime. Accordingly an ideally prepared clinker would have a coefficient of decomposition of unity.

The quality of the clinker naturally depends on the degree of decomposition, for the more the bicalcium silicate is enriched with lime, the more reactive it becomes. Hence the degree of decomposition can be no measure of the absolute strength or reactivity of a clinker. This decreases in the first place not in the same ratio but at a much

greater rate than the coefficient of decomposition. On the other hand different clinkers with the same degree of decomposition can contain different proportions of flux, which do not take an essential part in the hydration and accordingly do not influence the reactivity of the clinker according to the mass present. The following formula takes these conditions into consideration on empirical grounds and in accordance with the best thermochemical theories and gives for the reactivity or value of a clinker the following: Coefficient of reactivity = (degree of decomposition)³ × quantity of the active components.

Among the active components is included the content of the clinker in lime-rich bicalcium silicate, that is silica plus the total lime minus the lime in the flux. The reactivity or valency coefficient of the clinker must be a measure of the strength properties of the clinker that are to be expected. Thus cements with the same valency coefficients should give the same strength figures at the same degree of fineness, the same gypsum content, etc. Cements with different valency coefficients should vary as far as their strength is concerned somewhat proportionally with these coefficients, provided that the fineness of the grinding is the same.

An example of calculating the valency or reactivity coefficient is as follows. The degree of decomposition of the clinker in the aforementioned example is 0.928, the quantity of the active components amounts to $21.40 + (64.10 - 14.94) = 70.56$ percent. The coefficient of reactivity of valency is therefore $0.928^3 \times 70.56 = 56.4$.

In adjusting the proportions of a clinker the valency coefficient, as has been explained above, is of particularly great value. Thus the coefficient of the aforementioned clinker was 56.4. In order to increase this the lime content must be increased and there are two ways of doing this. The first consists in greater fineness of grinding of the raw cement and stronger burning. Both are however dependent on mechanical considerations which cannot always be met in practice. There is however a second method of doing this and that is by increasing the flux content of the clinker, that is by adding iron oxide. The silica content and the proportion of active ingredients thereby become less, but the degree of decomposition can be increased by increasing the residual melt; hence an improvement in the clinker is possible under these conditions. The action of higher flux content on the degree of decomposition can be easily determined in test clinker samples by means of White's reagent, and the calculation of the coefficient of reactivity affords an idea of the expected improvement.

Expert Sounds Warning to Employees of Effects of Impure Water

The American Water Works Association held its annual convention in Chicago during the week of June sixth. During one of the sessions some pertinent remarks were made by M. F. Tiernan, president of Wallace and Tiernan, to the effect that manufacturers and industries generally should make sure of the purity of the water supply. This caution was sounded not only because of plant efficiency but because recent court decisions have been rendered holding employers liable for the recovery of damages by employees contracting infectious diseases by drinking the water supply in tanks.

Mr. Tiernan said: "Water can be purified by chlorination at the low cost of 5 cents a million gallons, so that the cost of purification is negligible and it will eliminate all risk of damage suits, to say nothing of the tremendous economic saving in increased hours of labor, improved efficiency from better health and more contented employees."

Government Business Methods

The United States, with 6 per cent of the world's population, employs 64 per cent of the world's telephones. The reason for this can perhaps best be brought out by contrast.

If New York—or any large American city—were Paris, France, the business man who wished to use the telephone would first have to buy his instrument from any one of about 25 manufacturers. Having secured this instrument, he would then apply to the government for a man to install it, since in France the government installs and maintains all telephone equipment. Once installed, the subscriber, if he is lucky, may be able to connect with some of his business associates and really talk over the wire. If, on the other hand, he is not so lucky, he may find his instrument out of service. He then reports the trouble to the Government Telephone Administration, which, in the course of human events, sends a man to the subscriber's premises to make the needed adjustment. Not infrequently this mechanical inspector tells the subscriber the difficulty lies in the instrument and that he should apply to the manufacturer for service. This the subscriber does, the manufacturer in turn (and in the course of time) sending an inspector. Upon arrival the inspector may say: "Why, this instrument is now obsolete. We do not carry the repairs any more. You will have to buy a new one."

The subscriber by this time may feel the value of the service not equal to the trouble involved and give up the ghost. Should he be endowed with perseverance, however, he may throw away his old instrument and purchase a new one—thus starting the government a la business cycle all over again.

USE OF MINERAL FERTILIZERS TO INCREASE

By Professor George A. Olsen,
Agricultural Director, The Gypsum Industries

IN THE desire to increase the use of various mineral fertilizers as the means of building up the fertility and productive capacity of soils there is the probability of an occasional failure largely due to the fact that not enough attention is given to the problem of plant adaptation and plant tolerance. Also, the restricted practice of either liming soil or applying gypsum or rock phosphate is not always advisable because any one of these three ingredients may be neutral in effect, providing the problem is one of adaptation rather than of tolerance or of deficiency in plant food. On the other hand, through the use of the lime and gypsum, for example, it is possible to get the combined effect of these two products and, with the inclusion of rock phosphate, obtain three effects which will increase tolerance and yield of crop.

Obviously a suitable soil medium for the growing of crops does not necessarily benefit the plants since the soil may be lacking in either sulphate, phosphate, or both. Nitrogen need not be considered where legumes are grown and the soils are properly inoculated with suitable bacteria nor is it necessary to bother with the plant needs for potash in many soils since legumes secure nitrogen, as is well known, from the air supply and the potash is made available by means of base exchange phenomena.

There are numerous cases showing that liming has made the land favorable for the production of large yields of certain kinds of grain and clover and unsuitable for other varieties. Liming has also frequently proved helpful in suppressing action of substances which are toxic to plants and increasing bacterial activity. In this connection it is of interest to know that some authorities hold that soluble alumina is toxic to plants and that lime renders it insoluble. Others contend that soluble alumina is only injurious to the extent that it unites with phosphoric acid and renders the phosphorus unavailable to plants and to soil organisms. Many authorities have also shown that liming influences the efficiency of the phosphates and under entirely different conditions the rock phosphate and other insoluble forms of phosphate are as readily available as plant material as are the more soluble forms of phosphate without the use of lime.

Many experiments have been conducted recently to show that the beneficial effects resulting from the use of acid phosphate may be almost, if not entirely, due to the gypsum it contains rather than to the availability of the phosphorus as plant material. For example in Bulletin Number 136 of

the University of Idaho Agricultural Experiment Station it is shown that applications of gypsum resulted in net increases of \$18.89 for wheat, \$21.53 for meadow mixture, and \$49.99 for alfalfa as compared with phosphorus net increases of \$0.23 for wheat, \$0.71 for meadow mixture, and \$8.14 for alfalfa. The net increases for lime were \$4.53, \$4.21, and \$4.08 in the same crop order as mentioned above, which clearly shows in this field that gypsum functions primarily as a sulphate plant material. In other instances there has been observed a direct need for phosphorus which eclipses the influence of either lime or gypsum.

In Bulletin Number 232 of the Iowa Agricultural Experiment Station data are presented which show that applications of gypsum in an Eldorado field increased the yield of oats from 4.8 to 15 pounds. The soil showed a lime requirement of two and one-half pounds of lime per acre. The combination of the lime and gypsum increased the yield of oats from 6.8 to 17 bushels per acre and the yield of clover 680 to 2100 pounds per acre while limestone used alone increased clover 690 pounds. Obviously, the influence of the sulphate as plant material outweighed the benefit derived from the use of the limestone.

At Waverly, Iowa, lime and lime-gypsum applications decreased the yields of alfalfa while using gypsum alone increased the yields of alfalfa 800 to 1400 pounds. At Farson, Iowa, applications of gypsum increased the yield of clover from 40 to 460 pounds while lime decreased the yield 240 pounds. In the light of such facts, one would expect the combination of gypsum and limestone to end to depress the yield. However, as noted at Waverly the combination gave increases of 380 to 760 pounds of clover per acre.

Other tests conducted in other parts of Iowa show that there is a need for sulphate treatment. The use of lime with gypsum should prove most beneficial in those cases where the soils show response to lime treatment as well as to sulphate as plant material. The low efficiency of rock phosphate in quartz sand and its high efficiency in other soil types indicates different kinds of soil reaction. Usually soils which contain much iron and aluminum respond to phosphorus fertilization. Finely ground rock phosphate, known as floats, for example, is frequently used on acid soils which are high in organic matter and the more soluble form of phosphate is extensively used on the heavier soils.

Some experiments recently conducted show that silica gel favorably influences the solubility of the phosphorus in rock phosphate and has aided in

providing the phosphorus required by the plant. It is evident that on the physical and chemical make-up of the soil its productive efficiency depends. A system of fertilization therefore which will improve the physical nature of the soil and bring about desirable base exchange will increase the efficiency of the soil as a producer. The natural untreated minerals, under certain conditions, participate in the base exchange phenomena and improve the physical condition of the soil. The task ahead of us is to make mineral fertilization active under all conditions.

Road Building in Turkey

The total length of roads in Turkey is estimated at 27,985 kilometers (17,389 miles), of which only 7,200 (4,474 miles) are in good condition. Of the latter many are suitable for wheeled traffic only in the summer time, when the countryside is free of mud. The regions of Turkey where automobiles can circulate freely may probably be counted on the fingers of one hand. Even around Constantinople, where roads are better than anywhere else, good, metalled stretches are scarce. There are both national and local or vilayet roads, but the latter are much the most numerous. It was provided by law in 1925 that a road construction program was to be drawn up by the general council of each vilayet, to cover a period of five years. The law includes a provision obliging every Turkish citizen between the ages of 18 and 60 years, with certain exceptions, to pay a road tax in cash or kind.

Transportation Methods Change

By F. J. MacDonald

Methods of transportation have changed to a marked degree during the past years. The first method, by pack and sack, is now obsolete but some quarries are using methods today which are far from up to date or the best that could be employed. The transportation specialist has studied this problem but after all a man with a good practical experience can often suggest methods which are worth considering. This problem is very important to many plants and may determine the success or failure of the company involved. However, several things must be considered: First cost, operating cost, capacity, etc.

I recently came across a large cement plant that drew its stone at a distance of approximately 1,200 feet, with two-wheel one-horse dump wagons. As can be imagined it was hard and laborious work for the sorters to lift the stone into these wagons and it is only recently that this concern installed a track using steel dump cars moved by a steam locomotive to transport the stone.

A steam locomotive is a satisfactory system for

transportation when a large tonnage is to be moved, but the entire system must be kept in good order. Many things can cause trouble: poorly laid rails, bad ties, etc.; therefore this system should not be condemned unless the proper care is taken. I have seen cars off the track several times a day, and the steam locomotive also off the track owing to faulty track, and under such condition the company cannot expect a capacity transportation result. Another factor which must be watched is the locomotive boiler. Last year when repairing one of these boilers I found that the inside was filled with scale half way up to the first row of flue tubes, and each flue had at least $\frac{1}{4}$ inch of scale on it. This boiler was certainly using more fuel than it ought and could have been operated much cheaper if the operator had removed the scale.

One large plant, using the track system, purchased a \$1,200 electric locomotive to use for transportation. It was a quite handy, always-ready-power medium, but after three years service required to have all the batteries renewed. It is a good idea when buying equipment to find out if other users of such equipment find it satisfactory.

A superintendent at another plant, last summer, tried out transporting stone from the quarry in three trucks. The distance was about 800 feet, and trucks were hired for approximately 18 cents per ton. With a steam locomotive from 9 to 12 cars, with a capacity of $4\frac{1}{4}$ yards each, could have been moved and the material crushed in 8 to 10 minutes and as many as 30 train loads moved in 10 hours. However, when using the three trucks of 5 tons each the crusher was kept running constantly, which meant that it was empty two-thirds of the time with the unnecessary wear of the machine and added electricity cost. Again wear on the truck tires was excessive and after heavy rain the trucks were often stuck in the mud. Truck transportation is not a success for a large capacity crushing plant. For large capacity the rail system is best and the steam locomotive is proving the successful medium for moving the cars. However, in many plants the gasoline locomotive is being used profitably at a minimum transportation cost per yard or per ton.

With either system care and efficient operators mean economy in the long run, and to help in obtaining this it is recommended that during the winter months the engine house on the locomotive be heated.

The tractor is a useful machine to move the stone out of the quarry to the tracks and one tractor will pull two or three large dump cars each holding more material than a truck. Wear on the truck tires is also avoided when a tractor is used. When first cost is considered between tractors and trucks it can readily be seen that the former is the better way to handle this part of the transportation problem.

CONDITIONS AFFECTING AGSTONE MARKET IN BRITISH COLUMBIA

By E. R. Bewell,
Secretary Manager, Comox Limestone and Fertilizer Company

A SOIL demonstration of ground limestone and superphosphate of lime, under government aid and supervision, carried on in the British Columbia district last year proved that lime or limestone was badly needed. Tests for acidity showed the land to be very deficient in lime and growing of clovers and legumes proved that lime was lacking as it is almost impossible to grow them without fertilizers or lime. For several years the farmers here on Vancouver Island have been looking for a source of cheap limestone or lime, but the cost has been prohibitive and farmers would not and could not buy it.

Deposits of limestone are very scarce here at the coast; so transportation is a big factor in the price of it. I was stationed here at Courtenay, British Columbia, last year, or April, 1926. I looked about for a source of limestone as I had done at Duncan during the previous year while stationed there, where sources of limestone were available, but it was impossible to get any party or parties to raise the capital to commence operations there.

Investigations here at Courtenay showed a large deposit of high grade limestone on Texada Island where the Pacific Lime Company have large lime kilns and a lumber mill. They were crushing and selling it at a reasonable price but the freight rate here by water and commission made it prohibitive. After discussing the problem with the manager of the Pacific Lime Company, we decided that the logical place to do the crushing was at Courtenay and he offered to supply us with lime rock at \$1.00 per ton loaded on scows at their plant at Blubber Bay. This was a step forward and after considerable discussing of the matter with interested farmers, a meeting was called and it was finally decided to form a company incorporated with capital of \$10,000, 200 shares of \$50 each, and secure a crusher to produce ground limestone here at Courtenay.

It was planned to start operations last fall but several unforeseen delays occurred and it was not possible to start operations until after New Years, which proved to be a bad time to start as we got some severe snow storms and heavy rain. Roads were impassable, so farmers could not haul or get on the land if they did haul and considerable delay ensued. Costs of operating increased as we had to keep a scow at a large rent for several weeks longer than we should have done if weather had been favorable.

Four scowloads were brought over with a total

of 600 tons of lime rock. Towing charges, rent of scow, etc., cost nearly \$1.00 per ton against \$2.00 per ton wanted to bring over large shipments of crushed limestone. A combined crusher and hammer type of pulverizer was purchased which has been used throughout the season without any serious breaks, in fact no time has been lost waiting for repairs.

The limestone has been sold here at \$4.00 per ton in bulk and there was a good demand for it at this price. Two hundred tons were shipped by rail to other points on Vancouver Island. The railway gave a very low rate on this product ranging from 60 cents per ton for a short haul up to \$1.50 per ton on a haul of 150 miles, 30 tons being a minimum car, and prospects are for orders for 15 to 20 cars in sight when plant operates next fall. It will be a much better time to operate then, as the farmers will be able to get on the land then and it will have all winter to act on the acidity of the soil, and better results will be obtained than from a spring application. About 400 tons of limestone has been used in this district this season. About 50 tons was brought in and used last year when the government assisted to the extent of 75 per cent of the cost, and nearly every farmer that had two tons last year has taken from 2 to 40 tons each this year, and if results are seen this year again, the demand will likely reach 1,000 to 1,500 tons next fall, and will mean that a larger machine will have to be installed which would reduce costs, as a scow could be unloaded that much quicker and rent would be saved; also one man more is all that would be required to handle about double the output, which would be another big factor in reducing costs.

Several farmers want finely ground limestone so it may be necessary to install sieves for sifting and as there is considerable poultry raised here and in British Columbia, a good market may develop for limestone grits which can be produced and sold much cheaper than clamshell or oyster shell grits which cost the poultrymen from \$1.50 to \$2.25 per 100 pounds.

There is no doubt but that the finely ground limestone will give quicker results, but it will not last as long in the soil as where the coarse particles, which would be suitable for chicken grits, are applied too, as the coarse particles keep giving off calcium by weathering and the action will last over a longer period. It will require a larger application but it will be cheaper to secure, as every time an operation or handling is added, the cost

goes up so it will be necessary to increase the price to cover the extra handling.

This past season has been one of experience for the company and they have learned a lot about the business. It was a new thing to everyone connected with it and consequently several mistakes were made, but the cost of operating and sale price will break even for the season and a nice profit should be made on the next season's operations. It may be necessary to raise the price a little to be sure of making a small dividend to shareholders, although I feel confident that by rearranging the plant and operating in the summer when conditions will be much more favorable, a nice profit can be made without raising the price, which will be a big factor in making the use of it very popular.

Chain conveyors were constructed to start with but these were absolute failures and belt conveyors had to be installed. By rearranging the plant, the rock can be carried direct to crusher from scow in one operation and storage capacity can be greatly increased and a greater supply left on hand when through operating. Storage space has been used this season to store rock, which meant a lot of extra handling and added cost.

The Comox Limestone and Fertilizer Company was also formed to go into the fertilizer business but lack of space did not permit of this, this past season, but it may be developed next winter when the plant will not be required for the limestone, as it is hoped to get that part of the business wound up by December at the latest.

"B. F. Affleck" Launched at Toledo

The boat "B. F. Affleck," which cost a million dollars, was to be launched at Toledo, June 25. It was built by the Toledo Shipbuilding Company for the Pittsburgh Steamship Company, whose fleet of 90 vessels is the largest on the Great Lakes. The new steamer "B. F. Affleck" is one of the largest in this fleet. The boat is named for B. F. Affleck, president of the Universal Portland Cement Company, a subsidiary of the United States Steel Corporation, with plants at Chicago, Duluth and Pittsburgh.

Mr. Affleck left school at 13, entered a machine shop, studied nights, held clerical position in railroad office and later became salesman, general sales manager and then president of the Universal Portland Cement Company. He is a former president of the Portland Cement Association. Mrs. B. F. Affleck will christen the boat.

The boat will carry ore from iron range at head of the lakes to Lake Michigan and Lake Erie ports, limestone from Michigan to steel plants and cement plants at Chicago, Buffington, Gary, Lorain and Duluth, and coal from points on Lake Erie to ports on Lake Michigan and Lake Superior. The

freighter is a 12,000-ton vessel, 604 feet long and 60 feet wide. The motive power includes triple expansion engine and three Scotch marine boilers.

The boat is one of several units in lake-carrying development of Universal Company, a feature of which was the formal opening by Vice-President Charles G. Dawes on June 9 of the company's harbor at its Chicago (Buffington, Indiana) plant—the first private harbor to be built on Lake Michigan in 20 years. It is one of only three such harbors on all the Great Lakes. The others are at Gary, Indiana, and at Calcite, Michigan.

World Census of Automobiles for 1927 Shows Huge Gain

A total of 27,650,267 passenger automobiles, trucks and buses were in operation throughout the world at the beginning of 1927, as compared with 24,473,629 at the beginning of 1926, an increase of 3,176,368 according to a world census of motor vehicles just completed by the automotive division, Department of Commerce.

Automobile trucks and buses operated in the United States at the beginning of 1927 totaled 22,137,334, about 80 per cent of the world registrations. The United Kingdom ranked second with a total of 1,023,651, followed in order by France, 891,000; Canada, 828,918; Australia, 365,615; Germany, 319,000; Argentina, 222,610; Italy, 138,177; Spain, 135,000; New Zealand, 123,224.

Registration places America first with 23,486,172, followed by Europe, 3,164,739; Oceania, 522,083; Asia, 288,687; Africa, 189,006. Registrations in the United States at the beginning of the year totaled 2,086,058 more than the 1926 figures, with only 977,960 added in the rest of the world in the twelve-month period.

Enlarging Cleveland Public Auditorium

Work is progressing rapidly on the \$2,000,000 addition to the Cleveland Public Auditorium where the Convention and Road Show of the American Road Builders Association will be held next January. The size of the present structure is approximately 200 feet by 500 feet and is located in the center of the block between St. Clair and Lakeside Avenues. The addition to each end of the present structure will make the public hall one block long. This will provide about 45 per cent more exhibition space than the association had at the Coliseum in Chicago. The addition to the north end will be used to house conventions, etc., not large enough to warrant the use of the main building while the addition to the south will be used for small theater groups.

PIT AND QUARRY FOREIGN DIGEST

Burning of Pulverized Materials Below Their Melting Points

The strength attained by pulverized materials such as cement, clay, etc., when heated just below their melting points or eutectic temperatures is caused by the internal characteristics of the solid crystalline components. At a sufficiently high temperature the molecular vibration becomes so great that diffusion into neighboring granules takes place. This may result in an increase of granule size without alteration of the substance (recrystallization) or in reacting with several components several different crystallized materials may appear with evolution of heat. Those substances which undergo the internal diffusion process exhibit a very great increase in strength. Bernhard Garre (*Zement*, May 19, 1927. pp. 404-405).

Magnesium Oxychloride Cement

The aqueous vapor pressure of two magnesium oxychloride cements were made for 25 degrees C., in order to determine the state of the water in them. The vapor pressure is due, in one specimen of cement containing 33 per cent of water, mainly to the water of crystallization of the double compound $3 \text{MgO} \cdot \text{MgCl}_2 \cdot 12 \text{H}_2\text{O}$, whereas in the other, containing 55 per cent of water, it is ascribed mainly to a solution of magnesium chloride held by capillarity within the pores of the cement. Cements in which the water is held mainly by the former method are brittle, and surface sweating in a moist atmosphere is more marked, this being due either to the lower vapor pressure of its water or to the fact that the water cannot soak into the interior of the mass. T. Maeda (*Sci. Papers Inst. Phys. Chem.*, Tokyo. 5, 133-140).

Importance of Silica Conversions in the Burning Process

The thermal conversions of silica are classified as follows: (1) Non-reversible conversions occurring after prolonged heating or by the aid of catalysts and accompanied by considerable volume change and alteration in crystal structure, as, for example, quartz \rightarrow cristobalite, 1300-1350 degrees C., expansion 17.4 per cent. (2) Reversible conversions occurring practically instantaneously, but with little volume change or alteration in crystal structure, as exemplified by alpha quartz \rightleftharpoons beta quartz at 575 degrees C., expansion 2.4 per cent. Reference is made to the anomalous behavior of beta quartz in passing directly into cristobalite, and to the variable conversion temperature of alpha \rightarrow beta quartz (220-260 degrees), which is attributed to the presence of non-volatile impuri-

ties. The velocity of the different conversions is largely determined by whether the silica is present in the free state or solid solution, and also varies inversely as the size of the particles. In the manufacture of silica refractories the greater part of the quartz is converted to cristobalite, but complete conversion is only effected by prolonged heating at 1400 to 1450 degrees C. The reversible changes which introduce expansion and contraction mainly take place below 600 degrees C., the reversible expansion being greatest with cristobalite and least with tridymite. The use of a mixture of converted and semi-converted silica frequently results in the formation of cracks and fissures owing to the expansion of the non-converted material. Kieselguhr is converted into cristobalite by heating at 1100-1150, and, after conversion, its resistance to load between 1100 and 1700 degrees is almost equal to that of 95 per cent silica material. E. Steinhoff (*Gas u. Wasserfach*, 1927, 70, 237-240, 264-268 & *B. A.*, Vol. 46, 331).

Composition of Building Materials and Humidity Changes

Quartz, granite, the pure limestone, and highly burned brick show practically no absorption of moisture from an atmosphere saturated with water vapor. Sandstone absorbs some water and swells due to the contained amorphous building material. Absorption of dyes such as methylene blue parallels the absorption of moisture. Heating at 850 degrees C. destroys the colloidal matter present in sandstones, which then lose the power of absorbing water vapor or dyes. A stone preservative is defined as a substance which in the presence of water is preferentially absorbed by the mineral gel and remains permanently in combination with it. J. W. McBain & J. Ferguson (*J. Phys. Chem.* 1927. 31, 564-590).

Hardening of Magnesium Oxychloride Cements

The hardness of magnesium oxychloride cements was measured by a modified Vicat apparatus and indicated that hardening is a continuation of the setting process, and is due to the further formation of the double salt $3 \text{MgO} \cdot \text{MgCl}_2 \cdot 12 \text{H}_2\text{O}$. Insufficient absorbed water, resulting in a high proportion of solid constituents, causes the formation of brittle cements. Old specimens of magnesium oxide have a similar effect. Free water is essential to the plasticity of the cement. Soft cements have an excessive water content after hardening. T. Maeda (*Sci. Papers Inst. Phys. Chem. Res.*, Tokyo 5, 141-154).

Aluminous Cement and Ferrosilicon

Aluminous cement and ferro-silicon or high silicon pig iron are simultaneously produced by fusing in a blast or electric furnace a mixture comprising lime, alumina, silica and iron oxide in suitable proportions in the presence of sufficient carbon to reduce most of the iron and part of the silicon. The resulting cement should contain lime and alumina in the proportions $5 \text{ CaO} : 3 \text{ Al}_2\text{O}_3$, and should not contain more than 5 per cent of ferrous oxide and 15 per cent of silica. The ferro-silicon may contain 10-45 per cent of silicon. The invention renders possible the use as aluminous raw materials of siliceous bauxite or high alumina clays such as siliceous diaspore, kaolin and halloysite. E. C. Eckel (British Patent 268,736).

Concretes

Clay and sand containing stone dust are graded to pass through a $\frac{1}{8}$ " mesh sieve and mixed with stone chippings graded on a $\frac{3}{8}$ " sieve in the proportion of 4 parts to 1, and the mixture is graded on a sieve of 30 mesh, the residue passing through being sufficient to fill in the voids of the material left on the sieve. The percentage of clay in the mixture is calculated and additional stone chippings added if necessary to bring the percentage of clay to 5 per cent. One part of Portland cement is then added to 5 parts of the mixture and the product mixed with water and molded in place. I. F. Shellard (British Patent 268, 633).

Treating Sand

An apparatus for mixing, disintegrating, aerating and ejecting sand comprises a drum with staggered rows of pins arranged below a supply hopper with an adjustable outlet plate. The drum is arranged between side plates and is driven by a motor. The angle of the hopper may be altered by reason of its hook-bolt mounting and it may be replenished by a conveyor. It is stated that the sand is projected 25 to 40 ft. horizontally or to a height of about 9 feet, and also that any scrap metal is thrown out at the hopper inlet. G. Spencer (British Patent 267,261).

Acid Proof Cements

Acid proof cements are made by mixing a water-glass solution with a powder containing a compound of silicon (other than silica or silicates), which when boiled for two hours with 25 times its weight of 15 per cent caustic soda solution is dissolved to the extent of at least 40 per cent. Fluosilicates are particularly suitable, such as those of sodium, potassium, calcium and aluminum. I. G. Farbenindustrie Akt. Ges. (British Patent 267,396).

Silicates

A voluminous, almost gelatinous mass of hydrated calcium metasilicate is produced by treating finely ground silica with lime in the presence of water, with or without heating. Other alkaline earth oxides may be used. The product is either dried and pulverized, or the wet mass may be calcined and carbonated during or after calcination. The product may be used in the form of a slurry or thick suspension as a decolorizing material or a filter aid for sewage, oils, beet and cane sugar liquids, fruit juices, syrups, etc. It may be used as an absorbent for gases, moisture or liquids and malodorous substances, as a lubricant or for a long list of other purposes. A. J. Hadden (British Patent 268,011).

Clinker Constitution and Slip Standardization

Three series of researches were conducted. (1) Clinker was burned from pure SiO_2 , Al_2O_3 and CaO (CaCO_3). The composition was varied so that the Al_2O_3 content remained constant while the molecular ratio of $\text{SiO}_2:\text{CaO}$ altered from 1:2.4 up to 1:3.0. The burning conditions were regulated from the beginning of the sintering to complete fusion of each clinker mass. Tests were made of the reactivity of the clinker with burned and slaked lime, blast furnace slag and Portland cement clinker. At the normal sintering point the corresponding clinker with Alitic structure, up to a molecular ratio of $\text{SiO}_2:\text{CaO}$ of 1:2.59, was as good as completely resistant to the reagents mentioned. (2) In similar fashion the fused products of the binary system $\text{Fe}_2\text{O}_3\text{—CaO}$, as well as the ternary system $\text{Fe}_2\text{O}_3\text{—CaO—SiO}_2$ were investigated. For the system $\text{CaO—Fe}_2\text{O}_3$, those fusions containing less than 2 moles of lime to 1 of iron oxide were completely resistant to the reagents. The ternary system, with a constant content of Fe_2O_3 of 30 per cent, showed that no free lime (no reactivity with the test reagents) was present until the ration $\text{SiO}_2:\text{CaO}$ exceeded 1:2.60. (3) MgO does not react with the clinker formed in the above tests. This behavior explains the difference in effect of MgO in blast furnace slag and clinkers. Figure 1 shows oven used in these experiments. Dipl. Ing. K. Tremmil (Zement, April 28, pp. 329-332, May 5, 353-356).

Slag Cements

Gypsum or other sulphur compound is added to molten slag under reducing conditions so that the manganese oxide in the slag is transformed into sulphide. The lime content of the product is then corrected by addition of limestone. S. Michelsen (British Patent 267,539).

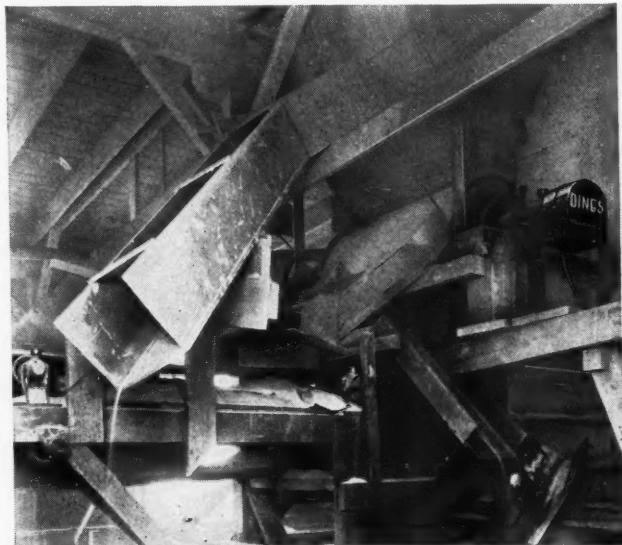
INTIMATE NEWS OF MEN AND PLANTS

United States Silica Company Adopts Unusual Method

An unusual method of separating from glass sand all magnetic material, such as hematite, magnetite, ilmenite, minute particles of iron abraded from the surfaces of crushers, screens or other iron machinery and even particles of iron attached to sand crystals, or entirely included in them, has been installed in the plant of the United States Silica Company at Ottawa, Illinois. The process, which is used in the manufacture of a sand of extremely low iron content necessary to meet the requirements of glass manufacturers where the color of the glass is of importance, has been developed in order to submit large quantities of sand to the highest possible magnetic intensity and makes use of a large capacity magnetic pulley with the material passing directly over the bare face of the pulley instead of over a belt as is the usual practice.

In order to remove magnetic particles collected on the face of the pulley a special control mechanism has been installed which demagnetizes the pulley for a few seconds approximately once every minute. At the same time a stiff brush extending the full width of the pulley is brought to bear against the pulley face on the back side. This brush, operating while the pulley is demagnetized for a second or two removes all magnetic particles which have been seized, the collected magnetic particles falling into another chute.

Immediately the face of the pulley has been brushed clean the magnetizing current is again applied by the automatic control mechanism. The entire cycle is repeated approximately once a minute. The design of the apparatus and automatic control was worked out by engineers of the Dings Magnetic Separator Company working in co-operation with the United States



Magnetic Pulley to Separate Metallic Substances From Sand

The sand, which is originally obtained by the disintegration of a high grade sand stone, is first submitted to intensive washings which eliminate the alumina and other non-magnetic materials contained in the sand stone. The sand is then fed by gravity from a large hopper in a thin stream, directly onto the bare face of a 48 inch Dings magnetic pulley on which the maximum current is carried. The extremely high magnetic intensity causes all particles of magnetic material such as hematite, magnetite, iron of abrasion, etc., to adhere to the face of the pulley, including even the crystals with iron attached or iron entirely included within themselves.

Silica Company. Approximately 75 tons of sand per hour are handled by the separator.

The process has been made necessary due to the fact that the Ottawa plant manufactures a glass sand which is sold on a guarantee that the iron content will not exceed a definite fixed percentage of iron oxide. Each batch of sand is accompanied by an analysis of iron oxide made as a matter of routine by the R. W. Hunt Company and over a period of 13 months an average iron oxide content of 0.0184 per cent has been maintained. The highest iron oxide content reported over this period was 0.025 per cent and the lowest was 0.009.

New Oregon Lime Plant to Start First Unit

It is reported from Wallowa, Oregon, that at a recent meeting of the board of directors of the Black Marble Company definite plans for the construction of the first unit of the company's lime plant were adopted and it is expected that construction of the first kiln will start without delay. The first unit will consist of four kilns, two of which are to be constructed at once, and the material for which is already on the ground. Plans were drafted by E. Lazelle of Portland. The moot question that delayed the adoption of plans was as to the advisability of placing the kilns above or below ground, the contour of the land at the terminal point of the tram making the matter of the disposal system one to be considered carefully. It was finally decided to put the kilns on top of the hill, using the gravity system for disposal.

Tremendous Canadian Quarry Begins Operations

It is reported that the new plant which has been under construction for the past several months at Fort William, Ontario, for the Quinn Stone and Ore Company, Ltd., has gone into operation, the first boat, a self-unloader, taking the first cargo of crushed rock for a Detroit account.

The site of the new plant and quarry is on the navigable river Kaministiquia, where large boats, that ply Lake Superior, can go. The capacity of the plant to crush and prepare stone is 5,000 tons per day working two shifts, and assuming 150 working days per season, this is equivalent to a production of 750,000 tons annually. The Quinn Stone and Ore Company is a subsidiary of the Clement K. Quinn and Company of Duluth. The quarry occupies a very advantageous position, being a high bluff from which the rock may be moved by gravity. The hill is known as Mount McKay.

Kunze Lime Going Ahead

Construction has been started, according to a report, on a \$20,000 plant at South San Francisco for the Kunze Lime Company. Two kilns will be constructed with a daily capacity of 10 tons. A third kiln will be added on completion of the first two. Chas. Kunze of San Francisco is president of the company and Mrs. Adolph Kunze of San Carlos, secretary.

New California Lime Plant

According to reports, construction of a lime hydrating plant with a daily capacity of 50 tons is being pushed to completion at Tehachapi, California, by the Union Lime Company. Machinery for the big factory is being installed by the McGann Manufacturing Company. The Schulthess process, which has been adopted throughout Europe, and has been installed in many plants in the United States, will be used. E. B. Wyman, secretary and general manager of the company, is working out the details with J. C. Jones, superintendent for the McGann Company.

A special building is being constructed adjacent to the Union Lime kilns at H and Hayes streets, where suitable sidetrack and shipping facilities are available. The plant, which will establish a new industry in Tehachapi, will have a capacity of two and one-half tons an hour, and is expected to operate about 20 hours daily. Hydrated lime will be bagged in 50-pound sacks. Automatic machinery for weighing and sacking the product is to be included in the equipment, and to insure an adequate water pressure at all times, a pumping plant and tower will be connected with the well now on the lime company's premises. Approximately 250 gallons of water will be required hourly for the hydrating process.

Charles B. Jacobs Now Owns Rock Valley Company

Ditner Roorda, who installed the plant and was the president of the Rock Valley Sand and Gravel Company, Rock Valley, Iowa, recently sold his interests in the company to Charles B. Jacobs and took a position with a dredging company in Downey, California.

The Rock Valley Company is enjoying a good general business this season, largely in the state of Iowa. The South Dakota territory, which led in orders last season, has delayed in construction work owing to heavy rains and also to the fact that the state has delayed its usual appropriations for highway projects. The plant has recently added to its washing apparatus, thus avoiding the stripping of the three feet top soil of the pits. The Rock river floods last fall broke through the embankment for about 30 feet in width, separating the pit lake from the low river lands. However, aside from an occasional day's inability to operate, owing to high water, the damage was not very serious.

The great problem at present for this company is the fact that the railway company has not track scales

nearer than about 60 miles to the east and 100 miles west of the plant. The new ruling which became effective May 1, providing 3,000 pounds per yard as the minimum weight on washed sand where scales are not available, is making the difficulty as plastering sand tests are about 2700 pounds per yard and concrete sand approximately 2900 pounds per yard.

Huge Cement Merger Hinted

It is reported from New York that negotiations are under way for the acquisition of the Lehigh Portland Cement Company by the International Corporation, although officials of the Lehigh stated the reports were premature. The combination would give the International a productive capacity of 38,000,000 barrels of cement a year.

The International was organized as a holding company in 1919. It has acquired a controlling interest in ten established and operating plants in this country, Cuba, Argentine and Uruguay, with a present capacity of 14,700,000 barrels a year. The total assets of the corporation are nearly \$38,500,000. The Lehigh Portland Cement Company, which was organized in 1897, is one of the oldest and largest in the country, operating twenty-eight plants with an annual capacity of 23,400,000 barrels.

Big Stone Dust Contract

According to a report from Sturgeon Bay, Wisconsin, the Leatham D. Smith Stone Company recently started shipment of a new product from their quarry when the steamer "Way" took a cargo of stone dust to Muskegon as the first delivery of a 10,000-ton contract. This product is used for concrete sand and is saved from what was formerly a waste product at the quarry by being worked out through new machinery recently installed at the quarry. The company estimate that 250 tons a day of the waste material can be saved through this process.

Granite Quarry Reopened at Perris, California

W. C. Ricketts, it is reported, has reopened the granite quarry in the Schain property at Perris, California, and is taking out many carloads of high-grade granite. This is said to be a fair-sized deposit, and when it has been exhausted, Mr. Ricketts will move his crew over to his large quarry near Lakeview, where he says the deposit is so large that it will give him all he can handle for a year or two.

New Cement Plant in Maine Going Ahead Rapidly

From Maine comes the report that construction of New England's only cement mill, now being erected at Thomaston, has so far progressed that more than half the equipment has been ordered by the Lawrence Cement Company, who are investing over \$3,000,000 in this enterprise. This equipment includes a huge crusher, four large mills for grinding raw mix and clinker, another mill 26 feet in diameter, two rotary kilns, each 200 feet long and 11 feet in diameter, a rotating cooler somewhat similar in appearance to the kilns measuring 90 feet in length and 10 feet in diameter, four 800 horse power motors and four motor generator sets. This is only part of the equipment which will go into the mill, of course.

Oregon Again Interested in State Owned Plants

Reviving the "state cement mill" plan, investigated and dropped by state officials several years ago, Governor Hartley of Oregon recently addressed letters to Erle J. Barnes, state director of conservation and development, and Sam J. Humes, state highway engineer, directing these officials to make investigations of the feasibility of state manufacture of cement and operation of its own sand and gravel pits.

While some legislation may be necessary to enable the state to build a cement mill, the governor's letter to Humes says, there need be no delay in the state's acquiring and equipping its own sand and gravel pits. The governor's letter to Humes directs him to consider a report made in 1921 by R. H. Thomson of Seattle on the feasibility of a state cement plant. Barnes is directed to investigate operations of publicly-owned cement plants in other states and to have the state geologist make further investigation in that state.

Fiborn Limestone Company Installs New Equipment

It is reported that the Fiborn Limestone Company at Fiborn Quarry, Mackinac County, Michigan, has installed a special crusher which will grind fine the limestone screenings at the quarry and make them available for agricultural use. Several carloads will be produced daily at the very reasonable figure of approximately 70 cents per ton loaded on cars at the quarry.

New Incorporations

John N. Bos Sand Co., Nels Anderson, Supt., Box 26, Crimson, Ind. Illinois corp. with \$3,000 cap. in Indiana. Chicago office, 118 N. La Salle St. John N. Bos, Pres., 200 S. Humphrey Ave., Oak Park, Ill.; Nanko C. Bos, Sec., 241 Edgewood Place, River Forest, Ill.

Indiana Gravel Co., 400 Market St., Mount Carmel, Ill. \$25,000. George Daily, Pres.; Walter R. Kinzey, Sec.-Treas.; George Dunkel; Noble L. Eastham.

Baas Rock Co., Inc., Miami, Fla. C. F. Turner, M. E. Turner, John H. Bass. 100 shares, \$100 p. v.

Knoxville Marble Co., Knoxville, Tenn. \$525,000. Walter V. Clark, Benjamin P. Broome, O. T. Roehl, 215 N. Broadway.

Greenlaw Gravel Co., Inc., Kentwood, La. \$20,000. Ashleigh Harleston, Thomas G. Womack, Lord Harleston.

Coplay Cement Completes Construction Program

The Coplay Cement Manufacturing Company have completed the work on eight raw rock mining silos with a 5000 ton stone storage. This stone storage with silos was made large for supplying all composition for Mill "B" and Mill "C". The company formerly had two stone houses and rock mills for the two plants.

The new unit is located at Mill "C" and all crushing, drying, weighing, mixing and grinding is carried out at this point. The required amount of composition for Mill "B" is pumped into the kiln boxes 1900 feet distant from the Fuller-Kinyon pump. This work completes the construction program of the Coplay Cement Manufacturing Company.

Reclaiming Engine Pistons

Wherever gas engines are used there is of course accompanying wear on pistons and cylinders which in time will result in slapping and loss of compression. To replace pistons is sometimes expensive, especially in the case of older engines. Frequently worn pistons can be reclaimed by welding a bronze band to the piston by means of the oxyacetylene torch.

First remove all grease and dirt by washing thoroughly in gasoline. Allow the piston to dry by gas evaporation. Then, on a welding table, and with a hot acetylene flame the tip of which should be governed by the thickness of the metal and the experience of the operator, the top side of the piston is brought to a dull red heat. From a bronze rod that has been warmed, dipped in flux and placed under the flame, a thin

layer of bronze is flowed on. As the work progresses the piston is rotated on its edge until the band of bronze is completed. Two such bands welded after this fashion (one on either end of the piston) will give good result. While they may be of any width, the wider the bands the better the bearing surface.

When cooled the pistons are machined to fit the cylinders—new rings having been provided of course. Once in use bronze banded pistons will serve equally well, if not better than new ones. Only the best obtainable grade of bronze and flux should be used for this work.

New Arkansas Cement Plant Appears To Be a Reality

Our information concerning the new cement plant at White Cliffs, Arkansas, is that the Lime Products Company will erect a cement plant costing \$1,392,000, capable of producing 500,000 barrels. The financing of this project is completed. Contracts have not been awarded but the Lund Engineering Company as engineers will be letting contracts within a few days. The proposed plant will employ the wet process.

Feldspar in 1926

The crude feldspar sold or used by producers in the United States in 1926 amounted to about 209,600 long tons, valued at about \$1,607,000, or \$7.67 a ton, according to reports obtained directly from producers by the United States Bureau of Mines, Department of Commerce, in cooperation with the geological surveys of Maryland, New York, North Carolina, and Virginia. These figures show an increase of 13 per cent in quantity and 22 per cent in total value compared with 1925, and represent the largest production and value ever recorded. Feldspar was mined and sold in 1926 in 12 states,

namely, Arizona, California, Colorado, Connecticut, Maine, Maryland, New Hampshire, New York, North Carolina, Pennsylvania, South Dakota, and Virginia. The greatest feldspar-producing region is that which includes the Atlantic seaboard states, from Maine to North Carolina. This region reported about 93 per cent of the total production and value in 1926. North Carolina, the leading state, reported about 44 per cent of the total output; Maine, the second state by a very small margin, reported slightly more than 16 per cent; and New Hampshire, the third state, nearly 16 per cent. The average value per long ton in North Carolina was \$6.59; in Maine, \$9.07; and in New Hampshire, \$8.66.

Except for minor purposes, feldspar is prepared for use by grinding. This work is done principally by commercial mills; only a very small portion is ground by users in their own mills. In 1926 there were 29 commercial mills operated in 13 states, namely, California, Colorado, Connecticut, Illinois, Maine, Maryland, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, and Tennessee. These mills reported 225,362 short tons of ground feldspar sold in 1926, valued at \$3,775,797, or \$16.75 a ton, compared with 212,858 tons, valued at \$3,603,845, or \$16.93 a ton, in 1925, an increase of 6 per cent in quantity and 5 per cent in total value. Of the quantity sold in 1926, 199,215 short tons, valued at \$3,246,174, or \$16.29 a ton, was domestic feldspar, and 26,147 tons, valued at \$529,623, or \$20.26 a ton, was Canadian feldspar. Canadian feldspar was ground in three states in 1926—New Jersey, New York, and Ohio. These figures represent increases in production and value of domestic feldspar and decreases in Canadian feldspar as compared with 1925.

The production of crude feldspar by states in 1925 and 1926 is shown in the following table:

Crude Feldspar Sold or Used by Producers in the United States in 1925 and 1926

State	1925		1926 (a)	
	Long tons	Value (b)	Long tons	Value (b)
Arizona	(c)	(c)	(c)	(c)
California	6,077	\$49,881	6,200	\$49,300
Colorado	(c)	(c)	(c)	(c)
Connecticut	10,426	71,201	11,400	87,800
Maine	28,404	256,731	33,800	306,600
Maryland	4,554	26,438	(c)	(c)
New Hampshire	38,366	278,736	33,200	287,500
New York	10,474	70,446	15,500	157,800
North Carolina	76,806	496,563	91,400	602,000
Pennsylvania	1,330	4,722	(c)	(c)
South Dakota	(c)	(c)	(c)	(c)
Virginia	(c)	(c)	(c)	(c)
Undistributed	9,269	60,936	18,100	116,000
	185,706	1,315,654	209,600	1,607,000

(a) Figures for 1926 are preliminary and subject to revision.

(b) Value at mine or nearest shipping point.

(c) Included under "Undistributed."

DISTRIBUTION OF CEMENT

Portland cement shipped from mills into States in March and April, 1926 and 1927, in barrels*

Shipped to	March		April	
	1926	1927	1926	1927
Alabama	158,310	141,921	215,372	173,893
Alaska	917	305	957	1,037
Arizona	54,916	45,602	40,257	47,573
Arkansas	66,712	59,114	62,646	53,331
California	1,156,509	1,094,778	850,124	1,137,845
Colorado	81,623	47,912	104,386	86,431
Connecticut	78,962	109,035	149,459	179,863
Delaware	22,386	24,826	48,259	40,699
District of Columbia	63,249	95,396	82,579	89,048
Florida	402,888	290,682	323,909	271,575
Georgia	139,781	169,167	171,829	168,681
Hawaii	24,737	19,615	27,999	25,876
Idaho	42,131	35,047	47,688	32,063
Illinois	570,121	752,148	†961,612	956,012
Indiana	190,063	267,288	†310,301	411,087
Iowa	116,367	147,119	219,716	211,243
Kansas	182,003	166,110	204,165	203,368
Kentucky	88,790	111,854	†141,326	144,791
Louisiana	96,214	134,893	99,889	107,023
Maine	18,302	20,132	33,345	39,031
Maryland	132,720	231,780	199,076	224,405
Massachusetts	168,271	193,283	298,326	293,606
Michigan	396,643	525,901	†576,865	854,042
Minnesota	164,405	147,967	296,040	258,506
Mississippi	58,308	75,149	65,511	78,127
Missouri	332,104	287,825	505,850	312,311
Montana	17,203	19,365	23,063	23,882
Nebraska	121,456	81,860	170,591	96,255
Nevada	8,824	7,665	8,478	10,406
New Hampshire	18,043	25,391	37,909	43,932
New Jersey	424,812	611,542	†653,779	897,645
New Mexico	18,594	32,564	†15,861	28,566
New York	1,026,903	1,511,091	†1,633,864	2,131,528
North Carolina	271,422	235,316	357,978	324,758
North Dakota	23,260	20,429	39,039	38,157
Ohio	420,536	576,334	†674,151	851,619
Oklahoma	206,766	235,301	220,016	242,747
Oregon	117,611	91,820	126,874	122,281
Pennsylvania	745,395	864,996	†1,243,762	1,200,019
Porto Rico	2,500	2,500	1,000	1,000
Rhode Island	34,838	50,746	64,303	78,743
South Carolina	69,811	71,247	49,573	82,680
South Dakota	38,194	31,724	43,693	35,465
Tennessee	117,610	137,431	178,683	180,574
Texas	367,833	481,261	411,203	472,879
Utah	37,117	25,741	35,218	31,793
Vermont	5,052	9,397	14,358	30,185
Virginia	121,765	124,387	161,284	135,226
Washington	152,534	229,012	189,037	248,518
West Virginia	89,108	97,058	†154,310	112,065
Wisconsin	155,840	221,345	†277,248	356,961
Wyoming	12,225	10,293	13,887	14,733
Unspecified	37,724	16,486	†57,493	102,398
	9,467,908	11,017,151	†12,893,141	14,296,532
Foreign countries	71,092	65,849	71,859	53,468
Total shipped from cement plants	9,539,000	11,083,000	12,965,000	14,350,000

*Includes estimated distribution of shipments from four plants in April, 1926; and from five plants in March, 1926, and in March and April, 1927.
†Revised.

Production, shipments, and stocks of finished Portland cement, by districts, in May, 1926 and 1927, and stocks in April, 1927

Commercial District	Production		Shipments		Stocks at end of May		Stocks at end of April 1927*
	1926	1927	1926	1927	1926	1927	
Eastern Pa., N. J. & Md.	3,939,000	4,040,000	4,620,000	4,139,000	4,629,000	5,055,000	5,154,000
New York	861,000	1,006,000	928,000	956,000	1,418,000	1,673,000	1,624,000
Ohio, Western Pa. and W. Va.	1,825,000	1,558,000	1,921,000	1,538,000	2,697,000	3,400,000	3,380,000
Michigan	1,290,000	1,558,000	1,301,000	1,431,000	1,915,000	2,195,000	2,068,000
Wis., Ill., Ind., & Kentucky	2,238,000	2,189,000	2,598,000	2,336,000	3,456,000	3,130,000	3,277,000
Va., Tenn., Ala., & Ga.	1,428,000	1,456,000	1,420,000	1,453,000	1,068,000	1,146,000	1,144,000
Eastern Mo., Ia., Minn. & S. Dak.	1,518,000	1,440,000	1,777,000	1,382,000	2,819,000	3,289,000	3,231,000
Western Mo., Neb., Kan. & Okla.	1,116,000	1,037,000	1,131,000	1,070,000	1,430,000	1,723,000	1,756,000
Texas	454,000	462,000	447,000	573,000	515,000	314,000	425,000
Colo., Mont. & Utah	273,000	246,000	256,000	227,000	347,000	506,000	486,000
California	1,233,000	1,364,000	1,259,000	1,423,000	526,000	570,000	629,000
Ore. & Wash.	335,000	318,000	315,000	329,000	435,000	470,000	480,000
	16,510,000	16,674,000	17,973,000	16,857,000	21,255,000	23,471,000	23,654,000

*Revised.

Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico, in April, 1927†

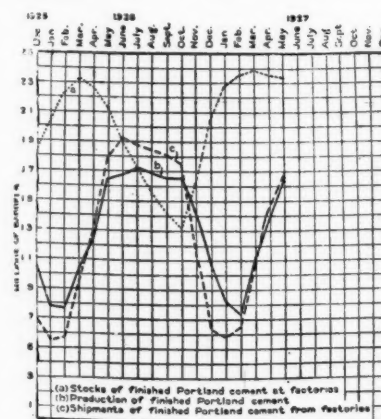
	Barrels	Value
Alaska	2,698	\$ 8,146
Hawaii	19,517	48,971
Porto Rico	10,101	23,481
	32,316	\$80,598

†Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

MAY CEMENT STATISTICS

Production of Portland cement is the greatest in any May, and shipments have been exceeded only in one other—May, 1926, according to the Bureau of Mines, Department of Commerce. Portland cement stocks show a slight decrease but are still high and are 10 per cent in excess of the stocks at the end of May, 1926.

The output of two more new plants, located respectively in Tennessee and West Virginia, is included for the first time in these statistics, which are prepared by the Division of Mineral Resources and Statistics of the Bureau of Mines and are compiled from reports for May, 1927, received direct from all manufacturing plants except two, for which estimates are necessary on account of lack of returns.



Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,628,682. Method of constructing concrete walls in deep trenches. Frank P. Noe and Seth M. Gooder, Chicago, Ill.

1,628,708. Combined tile and concrete floor construction. George H. Bugenhagen, Minot, S. D.

1,628,752. Form for concrete wall construction. Walter R. Sproul, Chicago, and Hugo Layer, Winnetka, Ill., assignors to E. W. Sproul Co., Chicago, Ill.

1,628,915. Cement-measuring and water-proportioning device. John F. Robb, Cleveland, Ohio, assignor to Koehring Co., Milwaukee, Wis.

1,628,985. Loading-machine. Joseph F. Joy, Pittsburgh, Pa., assignor to Joy Mfg. Co., Franklin, Pa.

1,629,103. Protected concrete pile and method of making same. Frank S. Honberger, Los Angeles, Calif.

1,629,276. Concrete-pavement-finishing machine. Orin L. Kipp, St. Paul, Minn.

1,629,611. Concrete-road machine. Edward G. Carr, Chicago, Ill.

1,629,470. Marine wall construction. John P. Ball, Chicago, Ill.

1,629,485. Holding-clip for concrete reinforcement. Clarence L. Dewey, Michigan City, Ind., assignor to Cement-Gun Co., Allentown, Pa.

1,629,622. Construction of concrete piles or columns. Alfred Hiley, Rickmansworth, England.

1,629,634. Dipper-door latching and unlatching means. James A. Orndorff, East Palestine, Ohio.

1,629,714. Cement composition. Charles E. Kraus, Babylon, N. Y.

1,629,803. Grate for ball-mills and method of making same. Frank E. Marcy, San Diego, Calif.

1,629,890. Frame construction for excavator-trucks. George T. Ronk, Fairfield, Iowa.

1,629,947. Means for sinking concrete piles. Maurice Blumenthal, Brooklyn, N. Y.

1,630,194. Rock or ore crushing machine. James G. Malone and John A. Dormer, Detroit, Mich.

1,630,221. Loading-skip for concrete-mixers. Samuel Shafer, Jr., Milwaukee, Wis., assignor to Chain Belt Co., same place.

1,630,231. Longitudinally-extensible boom for excavating-machines. George A. Vaughn, Newton, Iowa, assignor to Parsons Co., same place.

1,630,255. Cutting apparatus for mining-machines. James Cameron, Henryetta, Okla.

1,630,377. Propelling mechanism for cranes. Eugene G. Deucher, Cleveland, Ohio, assignor to Universal Crane Co., Elyria, Ohio.

1,630,456. Grab. William G. Wehr, East Cleveland, Ohio, assignor to Cleveland Crane & Engineering Co., Wickliffe, Ohio.

1,630,472. Mining-machine skid. Edward J. Doberstein, Blue Island, Ill., assignor to Goodman Mfg. Co., Chicago, Ill.

1,630,502. Crushing-disk. Edgar B. Symons, Los Angeles, Calif., assignor to Symons Bros. Co., Milwaukee, Wis.

1,630,794. Concrete-mold form. Will E. Keller, Los Angeles, Calif.

1,630,795. Mold form for building structures. Will E. Keller, Los Angeles, Calif.

1,630,796. Mold form. Will E. Keller, Los Angeles, Calif.

1,630,992. Air-swept ball mill. Harry H. Waterman, Strasburg Junction, Va.

1,631,029. Building form for concrete structures. George L. Hagy, San Antonio, Tex.

1,631,030. Trolley-bucket-rope take-up. Howard V. Harding, Hudson, N. Y., assignor to Gifford-Wood Co.

Production, shipments, and stocks of finished Portland cement, by months, in 1926 and 1927

Month	Production		Shipments		Stocks at end of month	
	1926	1927	1926	1927	1926	1927
January	7,887,000	8,258,000	5,674,000	5,968,000	20,582,000	22,914,000
February	7,731,000	7,377,000	5,820,000	6,731,000	22,385,000	23,560,000
March	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	23,922,000
1st quarter	26,008,000	27,087,000	21,033,000	23,782,000	.....	.....
April	12,440,000	14,048,000	12,965,000	14,350,000	22,710,000	*23,654,000
May	16,510,000	16,674,000	17,973,000	16,857,000	21,255,000	23,471,000
June	16,866,000	.....	19,134,000	.....	19,000,000	.....
2nd quarter	45,816,000	.....	50,072,000	.....	.....	.....
July	17,134,000	.....	18,812,000	.....	17,301,000	.....
August	16,995,000	.....	18,583,000	.....	15,718,000	.....
September	16,571,000	.....	18,087,000	.....	14,188,000	.....
3rd quarter	50,700,000	.....	55,482,000	.....	.....	.....
October	16,596,000	.....	17,486,000	.....	13,334,000	.....
November	14,193,000	.....	11,276,000	.....	16,243,000	.....
December	10,744,000	.....	6,432,000	.....	20,616,000	.....
4th quarter	41,533,000	.....	35,194,000	.....	.....	.....
.....	164,057,000	.....	161,781,000	.....	.....	.....

*Revised.

EXPORTS AND IMPORTS*

Exports of hydraulic cement by countries, in April, 1927

Exported to—	Barrels	Value
Canada	1,777	\$ 8,027
Central America	11,582	29,940
Cuba	10,880	28,789
Other West Indies and Bermuda	5,065	12,109
Mexico	8,911	29,133
South America	27,141	98,257
Other countries	7,027	37,577
Total	72,383	\$243,832

Imports of hydraulic cement by countries, and by districts, in April, 1927

	District into which imported	Barrels	Value
Belgium	Maine and New Hampshire.....	15,050	\$ 19,975
	Massachusetts	50,432	96,475
	New Orleans	9,544	12,438
	New York	50	84
	Philadelphia	26,433	38,255
	Porto Rico	5,000	9,205
	Rhode Island	16,757	23,059
	San Francisco	6,000	7,529
	South Carolina	4,007	7,669
	Washington	100	237
	Total	133,373	\$214,926
Canada	Saint Lawrence	1,500	4,218
Denmark and Faroe Islands.....	Porto Rico	33,482	47,364
France	New Orleans	316	1,606
	New York	50	605
	Total	366	2,211
Norway	Philadelphia	5,000	6,340
Turkey in Europe.....	New Orleans	500	1,049
	Philadelphia	647	1,526
	Porto Rico	17,000	35,628
	Total	18,147	38,203
	Grand total	191,868	\$313,262

Exports and imports of hydraulic cement, by months, in 1926 and 1927

Month	Exports				Imports			
	1926	Value	1927	Value	1926	Value	1927	Value
January	72,939	\$ 216,431	75,346	\$254,072	360,580	\$ 576,717	193,175	\$269,661
February	73,975	220,706	71,404	233,985	314,118	527,948	130,421	200,680
March	69,080	205,647	67,956	240,165	493,241	812,968	181,145	261,519
April	96,296	284,772	72,383	243,832	257,302	398,114	191,868	313,262
May	78,601	224,365	.....	.....	223,130	337,031	.....	.....
June	80,684	248,814	.....	.....	335,570	495,744	.....	.....
July	130,822	370,220	.....	.....	250,862	395,981	.....	.....
August	64,946	216,489	.....	.....	350,638	560,532	.....	.....
September	70,920	239,174	.....	.....	194,129	308,224	.....	.....
October	69,389	225,874	.....	.....	263,403	386,335	.....	.....
November	76,598	238,103	.....	.....	55,233	82,949	.....	.....
December	89,976	305,238	.....	.....	151,850	246,293	.....	.....
Total	974,226	\$2,995,833	.....	.....	3,250,056	\$5,128,836	.....	.....

*Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

NEWS OF EQUIPMENT MANUFACTURERS

Beaumont Cable Drag Scraper Described in New Bulletin

The R. H. Beaumont Company has recently issued catalog number 95, describing and illustrating the Beaumont cable drag system, which has for years been recommended as a simple solution of the ground storage problem and for stripping overburden, and working bank deposits of sand, gravel, clay, etc., combining high capacity and low first cost as well as low maintenance and operating cost. In this system equipment is reduced to a simple form, consisting of a few rugged parts—scraper, double drum scraper winding machine, cables, sheaves and fittings—all under one-man operation. The operation is thus described:

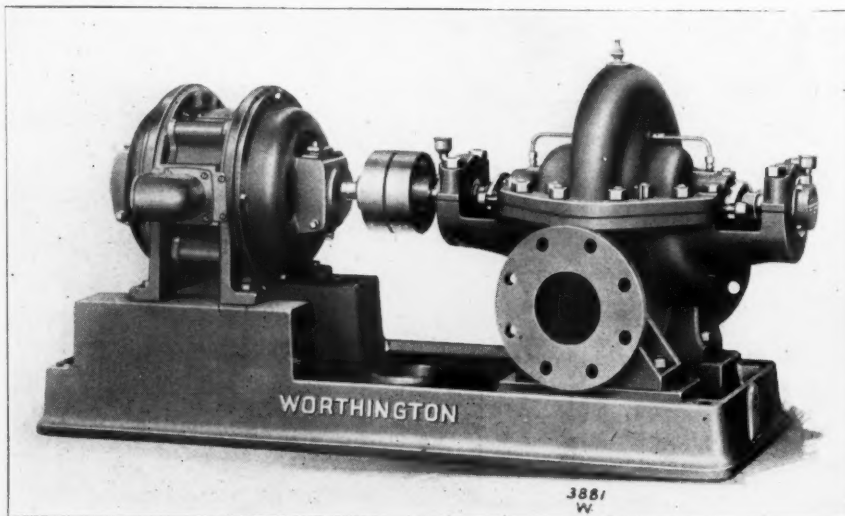
A cable to which the scraper is attached is the connecting link between the scraper winding machine and the outer limit of the haul, allowing great flexibility of operation. One cable—the load cable—runs direct from the front drum of the scraper winding machine to the front bridle of the scraper; a second cable—the return cable—runs from the rear drum of the scraper winding machine out over the haul and thence over the necessary blocks back to the rear attachment of the scraper.

By throwing a lever the operator puts the pull on the front drum, placing the load cable in operation, and the scraper at the digging point is pulled forward and the cutting edge digs, the material loosened filling the scraper. When the scraper is filled it floats on its load over the ground to the discharge point. By releasing the front drum and throwing a lever to engage the rear drum the return cable is put in operation, returning the scraper for another load. The scraper is dragged back and forth and the material can be brought from any desired place on the haul to the discharge point.

The catalog contains many illustrations of the system in actual operation as well as diagrams of installation and storage. There are also pictures and specifications of the Beaumont-LeClair cable drag scraper, and of various types of the Beaumont double drum scraper winding machine and fittings, as well as equipment for permanent installation of the system. The Beaumont tail block car system, slackline cableway excavator, skip hoist, tram-lift, gates for sand, gravel and stone are also listed and illustrated.

New Centrifugal Pumps

Several new lines of general service pumps have recently been developed by the Worthington Pump and Machinery Corporation—the result of a detailed study and analysis of pump services with a view towards designing new lines of high efficiency, especially for those heads and capacities



New Centrifugal Pump Double Suction Type High Efficiency

most commonly specified by users.

Among the outstanding features of these new pumps may be mentioned the pump casing, which is split horizontally. The design is such as to produce a smooth flow with no abrupt changes in velocity from the suction inlet to the discharge outlet, effecting a higher hydraulic efficiency. The volute form of the suction passage results in streamline flow to the entrance of the impeller. In the single-suction pumps the back of the impeller acts as a hydraulic balance. Double action pumps are inherently balanced hydraulically.

These pumps are now being carried in stock for standard motor speeds up to 3600 r.p.m. The new lines available embrace three types, as follows: A single-stage, single-suction type (R and S); a two-stage, single-suction type (U), and a single-stage, double-suction type (H, L and M). The construction is such that no pump will overload a standard motor of the horsepower and speed specified under any operating conditions to which the pump may be subjected.

The Climax Engineering Company announce the appointment of the James McGraw Company, Richmond, Virginia, as their sales agents in Richmond and vicinity.

Bakstad Crusher Bulletin

A machine that combines three crushers in one and accomplishes both primary and secondary reduction in one operation is described in an illustrated folder issued by the Bakstad Machinery Company. A full description of this crusher was published in the May 25 issue of Pit and Quarry.

Small Alternating Current Contactors Now Made

The General Electric announces a small alternating-current contactor for general application, self-contained on a molded base measuring 6½ inches by 4½ inches, and providing two main poles rated at 15 amperes and a normally open interlock. This device takes from three to six watts and will, therefore, operate from a 50-watt bell-ringing transformer. The molded shaft used is relatively new in contactor construction. The shaft bearing itself is of bakelite and operates in bronze shaft bearings. The contactor bears the G. E. designation CR-2810-1332, and is made in four forms.

Link-Belt Appoints

The following changes have been announced in the personnel of the Link-Belt Company: Mr. R. P. Shimmis has been appointed assistant to the chairman and the president, and will hereafter make his headquarters at 910 South Michigan avenue, Chicago. Mr. Frank B. Caldwell is appointed sales manager with headquarters at the Thirty-ninth street plant, and will have supervision over all sales activities in the Western division.

Worm Gear and Drives Feature New Bulletin

The Fawcus Machine Company has recently issued an interesting illustrated booklet, Bulletin E, explaining the construction and application of the Fawcus Timken-bearing worm drive WT type, their latest improved production. All Fawcus worm drives are made to order and each customer's requirement is handled individually. A drive is recommended and built for a particular purpose, receiving individual care and fitting in the company's shop to insure the best service that is obtainable, and each drive is tested and run in before shipment so that when put to work it goes into action at once without any of the grievous breaking-in troubles so often experienced with new machines.

Among the illustrations are interior views detailing the bearing construction and exterior views of special arrangements, including a worm-driven dredge hoist, a special vertical type used on a lime hydrator, and installations of lime and stone conveyor and elevator hoists.

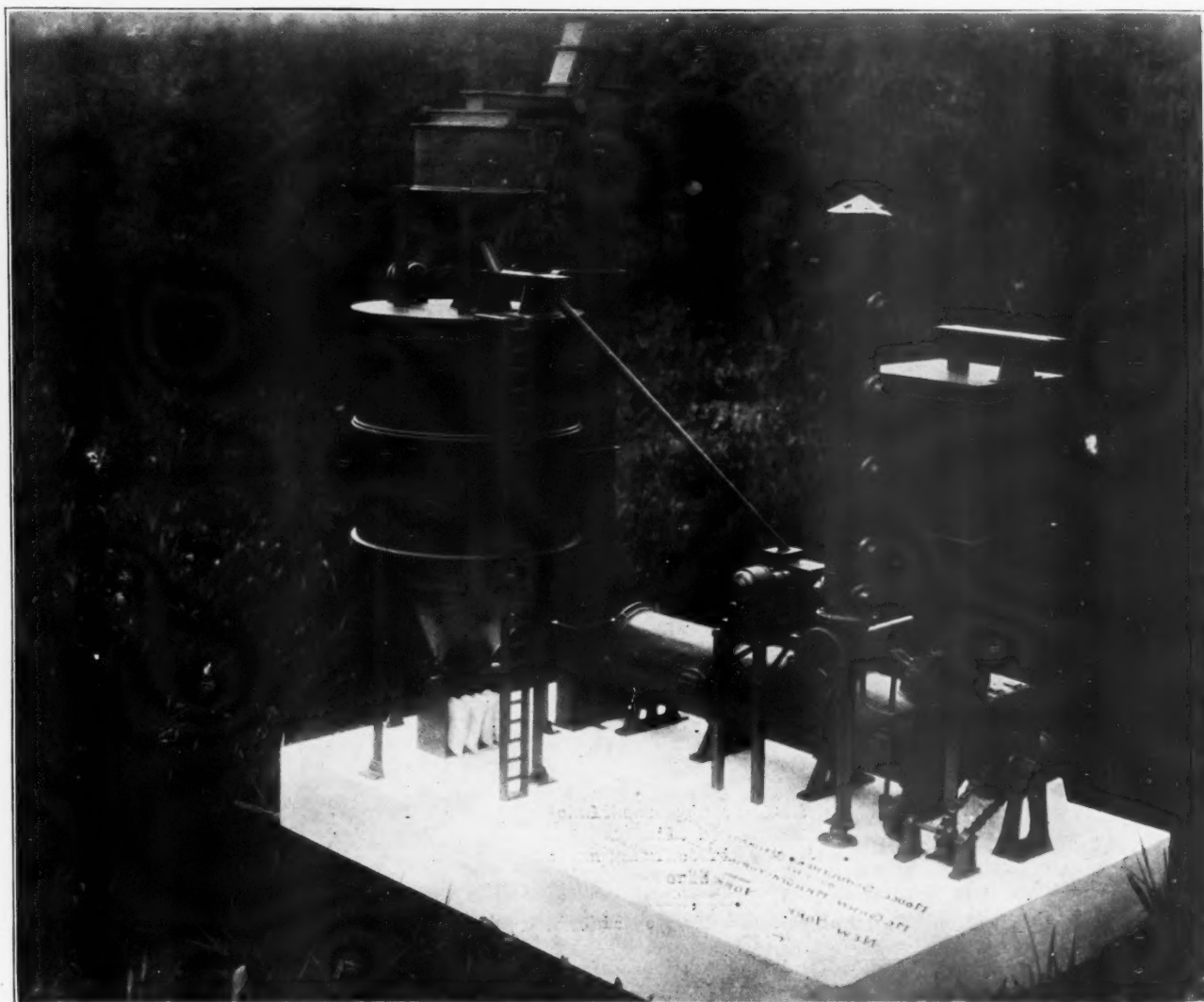
New Raymond Units and Drying Equipment

"A New Frontier" is the title of a new catalog recently issued by the Raymond Bros. Impact Pulverizer Company describing and illustrating recent developments in Raymond pulverizing, drying and air-separating machinery. Heading the list of notable innovations in this line is the Raymond kiln-mill, which dries and grinds materials in one operation, thus eliminating the expense of separate dryer equipment. This machine represents another advance in grinding methods. As practically every pulverizing problem entails a drying problem, this innovation is of great economic importance to the process industries because of the savings of time and money in the fine grinding of all products which are difficult to reduce on account of the presence of moisture in the raw materials.

The Raymond Imp mills are intended for individual pulverizing operations where the chief need is compact size of equipment and only a small capacity is required, while the

Raymond super-mills, super-screen mills and the Leviathan mills meet the requirements for large-scale production, with capacities ranging from 15 to 25 tons of finely ground material per hour. There is also the redesigned number 0000 pulverizer, for efficiently pulverizing small amounts of soft material, a compact motor-driven unit equipped with air-separation and a self-regulating feed adjustable to any capacity.

Recent improvements in Raymond mills and pulverizers afford many advantages through the elimination of labor and supervision and afford economies in operation and upkeep as well as increased capacity and better quality of output. They include an automatic feeder, for regulating both the quantity and fineness of the material fed and a pneumatic feed control for maintaining maximum capacity by automatically adjusting the rate of feed to meet variations in the load on the mill. There is also an automatic throw-out attachment which removes hard foreign matter to insure the delivery of a pure product.



The Model of the Schulthess Hydrator Manufactured by the McGann Manufacturing Company as It Was Displayed at the Recent Convention of the National Lime Association at White Sulphur Springs

Powdered Coal Machinery Described in Catalog

The Kennedy-Van Saun Mfg. and Eng. Corporation recently issued bulletin number 12 describing the application of powdered coal to steam boilers, cement kilns, dryers, etc. The pulverization of materials may be accomplished in several ways: By rolls, attrition mills, chopping machines and impact mills. Crushing rolls when introduced in America were used for the reduction of ores for amalgamating purposes where impalpable powders or slimes were to be avoided as much as possible. Attrition mills were used in the early days by the Romans for making cement or the grinding of ores. However, the capacity of this type of grinding apparatus is limited for pulverization purposes, due to the fact that when it was set close enough for pulverizing product they had very little capacity. The type of machine known as a chopping machine was originally used for cutting up hay and straw for stock food purposes, and this principle has been used in some coal pulverizing machines.

Impact mills as made by this company consist of a ball or tube mill, which is a slow-speed mill. It is built in various diameters from 24 to 96 inches and length desired for producing a given tonnage. Material is fed into the mill in desired quantities from a disc feeder preferably driven by a ¼ horsepower variable speed motor. The mill is rotated at a speed which causes the balls to be carried around by a centrifugal force to a point where they are thrown down on the material to be ground. The result is a continuous cascade of balls delivering thousands of blows per second.

The air-swept tube mill has no mechanical discharge. An adjustable opening in the feed housing admits, preferably, preheated air in desired quantities. A fan connected to the discharge end trunnion and driven by a variable speed motor draws air through the mill, removing only the impalpable powder through the discharge end of the mill, thus controlling the velocity of the air through the mill and thereby the fineness of the product. Additional air for combustion is admitted between the discharge end of the mill and the fan housing, from which the coal is delivered to the furnace under the boiler or to the metallurgical furnace. By this air-swept tube mill method the coal is ground in air, and a carburated fuel is thus prepared for the furnace, thereby enabling the oxygen and the carbon to combine for combustion, which is much quicker on account of the coal being reduced to an impalpable powder or dust. It is

claimed that coal pulverized in this machine is of sufficient fineness so that 80 to 95 per cent will pass a 200-mesh sieve and this machine deliver it to the furnace by air.

The book has also illustrations of installations of this type of apparatus and charts giving heat losses due to excess air at various gas temperatures; capacity of chimneys; capacity loss from moisture and other engineering data and tables.

New Electrical Devices

A number of new electrical mechanisms are announced in recent bulletins of the General Electric Company. Bulletin GEA-101A describes and illustrates station oil circuit breakers, types FK-, FKO-, FHK- and FHKO-236, 15,000 to 88,000 volts, 400 to 1200 amperes, with a range of rated interrupting capacities from 175,000 to 500,000 KV-A for moderate and heavy duty. These are liberally designed, conservatively rated and substantially built for either indoor or outdoor service at any altitude, those for outdoor service being equipped with cover pipes for the operating pipes and weatherproof housing for the operating mechanism.

Types FK-230 and FHK-230 of station oil circuit breakers are shown in bulletin GEA-706. This line is designed for medium and heavy duty for indoor service on systems of large capacity. They are built with tank diameters of 16, 20, 24, 28 and 32 inches, with ratings of 15,000 and 25,000 volts, at 600 to 3,000 amperes. Type FHK-230 is also made in ratings of 37,000 volts at 600 to 2000 amperes. Ratings of interrupted capacities range from 16,000 to 60,000 amperes at 15,000 volts, 10,700 to 35,000 amperes at 25,000 volts, and 22,000 amperes at 37,000 volts.

Selsyns, for distant signaling; control and indication, are described in bulletin GEA-722. These units are essentially small motors which, when interconnected, operate so that one motor reproduces any motion imparted to the other. They provide a reliable, rapid and accurate means of indication, control and signaling and can be used with combinations of electric and mechanical machinery where the source of control is remote from the controlled equipment and where the controlled equipment permits the adaptability. The generator is commonly called the transmitter, and the motor is called the indicator. The generator is located at the point of actuation and the motor at the point of reception.

Bulletin GEA-763 treats of induction motors of the isolated type, 220 to 2,200 volts, 25 to 60 cycles, 3-phase non-

grounded 3-wire, for motors with wound or squirrel-cage rotors. These are designed for use with types MT and KT induction motors driving centrifugal pumps and compressors, fans, gyratory crushers in cement plants and similar machinery for which the duty is uninterrupted, as contrasted with operation in cycles as in the case of rolling mills and mine hoists.

New Elevator Book Issued By Link-Belt

"Link-Belt Typical Elevators" is the title of an instructive new book recently issued by the Link-Belt Company, and which will prove of unusual value to all interested in handling materials. Its 44 pages of text and illustrations include examples, ratings, capacities and tables for use in selecting elevating equipment.

There are two general types of elevators in general use, known as the centrifugal discharge and continuous bucket types. For convenience in selection they are divided into three classes, corresponding to the weight and nature of the material to be handled. This company, backed by fifty years' experience in designing and building elevators, offers equipment applicable to handling practically all loose materials in bulk.

Jeffrey Apron Conveyors

The Jeffrey Manufacturing Company has recently issued catalog number 435, illustrating and describing the Jeffrey line of standard apron conveyors in wood and steel types for general conveying service. Out of a half century of experience in designing and manufacturing material-handling equipment to meet the requirements of various industries Jeffrey engineers have succeeded in standardizing Jeffrey apron conveyors so that special designing is completely eliminated, saving not only extra cost to the purchaser but simplifying the task of specifying this type of equipment. The book contains, besides full and detailed illustrations, a large number of carefully prepared and conveniently arranged tables which make it possible for the layman, as well as the engineer, to select the proper conveyor to meet his requirements.

Harnischfeger Personnel For Sales Increased

Harnischfeger Sales Corporation announces that, owing to increased volume of business, it has made the following additions to its sales departments: Mr. R. S. Breyman, Mr. M. A. Germond, Mr. D. Craze, Mr. Deane S. Holt and Mr. J. C. Yetter.

The Funderm Shovel

The Funderm Hoist and Shovel Company has issued an interesting folder illustrating their $\frac{1}{2}$ yard shovel, which, though small, has been aptly termed "the wizard of modern diggers." The design of this machine is simple and sturdy and the makers claim that it has fewer parts than any other shovel. This means that there are fewer parts to wear and that it requires little power to operate, all the power being used for digging.



Funderm $\frac{1}{2}$ Yard Shovel

The Funderm shovel is built to meet the demand of modern excavating practice—to do all kinds of digging speedily and to handle small and average-sized jobs efficiently where larger machines would work at a loss. It is also an ideal outfit for sand and gravel pits, quarry operation, road building and general utility. The machine is provided with flexible full crawls, which enables it to travel under adverse conditions. For the gasoline shovel a Fordson tractor is used, and for the electric shovel a 20-horsepower 900 r.p.m. heavy duty motor.

New Haulage Locomotive

A marked advancement in the development of electric mine locomotives for main haulage was represented by the new 20-ton Baldwin-Westinghouse locomotive recently completed for the Bertha-Consumers Company. This locomotive was demonstrated for the first time at the recent exhibit of the American Mining Congress in Cincinnati, prior to its shipment to Burgettstown, Pennsylvania, where it will be placed in service in Bertha Mine. It is the most powerful locomotive of its type ever built, having a total capacity of 300 horsepower, supplied by two motors, which is unequalled in mine motor capacity for two-motored units.

The two motors are 250-volt, commutating-pole type, connected to the 6-inch axles with single reduction, 5 inch face, $2\frac{1}{2}$ D.P., helical gearing. The motors are inside hung and spring supported from the lower half of the motor frame. The principal dimensions of the locomotive are: track gauge, 42 in.; wheel base, 80 in.; width over trolley socket, $67\frac{1}{2}$ in.; width over all and over bumpers, 72 in.; height over all, excluding trolley pole, 45 in.; length excluding bumping

block, 17 ft. 4 in.; wheel diameter, 36 in.

The nominal rating of the locomotive is 10,000 pounds drawball pull at a speed of 8 $\frac{1}{2}$ miles an hour with the motors operating in parallel. On level track the locomotive will be capable of starting and hauling a 400-ton train. On a 1 per cent grade the locomotive will be capable of starting and hauling a 275-ton train.

General Tripp Passes

General Guy E. Tripp, chairman of the board of directors, Westinghouse Electric and Manufacturing Company, died June 14, in the New York hospital, New York. His death was due to complications following an operation. Guy Eastman Tripp was born in Wells, Maine, April 22, 1865, a son of Alonzo K. and Abbie F. (Yeston) Tripp. He was educated at South Berwick (Maine) Academy, and at the age of 18 entered the employ of the Eastern Railway Company as a clerk, in which service he continued for seven years, being promoted to the position of chief clerk of the maintenance of way department. In 1890 he became storekeeper for the Thompson Houston Electric Company, which was under contract for the electrification of the West End Railway of Boston. Shortly afterwards he was made traveling auditor for this com-

pany, in which capacity he visited and reported on many public utilities.

In 1897 he became associated with Stone & Webster, constructive engineers and operators of public utilities, occupying successively important positions. In 1910, when Stone & Webster were called into consultation on the affairs of the Metropolitan Street Railway Company of New York, which had passed into receivership, Mr. Tripp was appointed their special representative and in this capacity met the requirements of the situation so acceptably that he was selected as chairman of the joint committee on reorganization. After he completed his work as Chairman of this committee he was selected for the position of chairman of the Board of Directors of the Westinghouse Electric & Manufacturing Company, assuming his duties February 10, 1912, in which capacity he continued until his death.

Shortly after the United States entered the World War, the problem which confronted the War Department was how to secure upwards of \$16,000,000,000 worth of war material in the most rapid and efficient manner. Because of his intimate knowledge of manufacturing and his broad executive experience, Mr. Tripp was selected as chief of the production division of the ordnance department, U. S. A. He entered the service in January, 1918, as a major in the ordnance department, and within ten months was made a brigadier general and assistant to the chief of ordnance of the United States Army. Upon leaving the service immediately after the Armistice, he was awarded the distinguished service medal by the President for particularly meritorious service.

Recognizing the importance of the rapid production of war material as a factor in our national defense, Mr. Tripp continued his co-operation with the War Department in its plans for industrial preparedness. He was a member of the advisory board of the New York Ordnance District and has been unremitting in his efforts in the work of organizing industry on an adequate defense basis. For several years he held the office of president of the New York Post-Army Ordnance Association.

In the past few years Mr. Tripp had manifested an especially keen interest in the future of electrical development in America. His war-time experience convinced him that power was an essential factor in our prosperity and he made an exhaustive study of the American power situation in order to determine the best and most efficient methods of power generation, transmission and distribution.

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion.....	\$3.75	\$7.25	\$10.75	\$14.25	\$17.75	\$21.25	\$28.25	\$31.75	\$35.25	\$42.25	\$56.25	\$70.25	\$105.00
2 Insertions.....	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions.....	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions.....	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	69.75	101.00
8 Insertions.....	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
18 Insertions.....	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions.....	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

INFORMATION—"Broadcast" space is sold by the advertising "inch." Each page contains 30 inches. The width of the page is divided into 3 columns, each 2 1/4 inches wide. Each column contains 10 inches measured the length of the column. Any space may be used measured by the even inch in height (not fractions),

by 1, 2 or 3 columns in width. The size of a space is its height in inches multiplied by the number of columns in width. Example: a space 3 inches high by 2 columns wide is 6 inches. Copy changes made without additional charge.

538 South Clark Street

Complete Service Publishing Company

CHICAGO

FOR SALE OR RENT

STEAM SHOVELS—RAILROAD TYPE

- 1—Model 80 Marion, Shop No. 1312, 4 yd. and 1233, 2 1/2 yd. dipper.
- 1—Model 60 Marion, Shop No. 2059, 2 1/2 yd. dipper.
- 3—60-C Bucyrus, Shop No. 1286, 1358 and 1640, 2 1/2 yd. dipper.
- 1—45-C Bucyrus, Shop No. 1202, 1 1/4 yd. dipper.

SHOVELS—FULL REVOLVING

- 1—80-B Bucyrus, Shop No. 4002, New 1924 caterpillars, 41-ft. 6-in. Boom, 34-ft. Dipper Arm and 2 1/2 yd. dipper.
- 1—Model 37 Marion, Shop No. 5395, Standard boom, 1 1/4 yd. dipper, A.S.M.E. boiler, steel caterpillars, available June 15th, Circleville, Ohio.
- 1—37 Marion, Shop No. 4773, 32 ft. boom, 22 ft. dipper arm, 1 1/4 yd. dipper. Caterpillars.
- 1—Osgood 29, Shop No. 1170, standard boom, 1 yd. dipper, steel caterpillars.
- 1—20-B Bucyrus, Shop No. 4103, stand, boom equipment, steel caterpillars, A.S.M.E. boiler.
- 1—Model 105 Northwest, Shop No. 1064 New 1926, steel caterpillars, 1 yd. capacity.
- 1—30-B Bucyrus, Shop No. 3922, Standard boom, 1 yd. dipper, steel caterpillars.
- 1—Koehring Gasoline Shovel, Shop No. 384, new, 1926. Standard boom equipment, 3/4 yd. dipper, steel caterpillar.
- 1—Type "B" Eries Shop No. 1219, high lift, 3/4 yard. Steel caterpillars.
- 1—Model 21 Marion, Shop No. 4294, steel caterpillars, 3/4 yd.
- 1—Type O Thew, Shop No. 1777, high-lift, traction wheels, 2/3 yd. dipper.
- 1—18-B Bucyrus, Shop No. 1870, 3/4 yd. dipper. Traction.

SIDE DUMP CARS

- 9—30 yd. Western, all-steel, air dump.
- 18—20 yd. Western, all-steel, air dump.
- 12—18 yd. Western, all-steel.
- 55—16 yd. Western, wood beds, air dump.
- 33—12 yd. Western Side Dump, wood beds.
- 2—6 yd. K. & J. Steel Sills Truss-rod doors.
- 7—5 yd. K. & J. 36-in. ga. Steel draw-sills, wood beds.
- 18—4 yd. Western 36-in. gauge, steel sills.
- 13—4 yd. K. & J., 36-in. gauge.
- 4—5 yd. Western, 36-in. gauge, heavy Duty.

- 5—2 yd. Western, 36-in. ga., wood draw-sills, wood beds.

STEAM SHOVEL PARTS

All repair parts on hand for Model 60 Marion and standard 70-ton Bucyrus Steam Shovels.

- 1—Std. boom, dipper arm and 3/4 yd. dipper for Type "B" Erie.
- 2—32-ft. and 40-ft. steel boom, drum, etc. for Type "B" Erie Crane.

LOCOMOTIVES

- 2—10x16 Davenport, Shop No's. 1918 and 1919, new 1922. Weight 19 1/2 tons. A.S.M.E. boilers. 36-in. gauge.
- 1—10x16 Vulcan 4-wheeled saddle tank, Shop No. 3266, 36-in. gauge, 19 tons.
- 1—10x16 Porter 4-wheeled Saddle Tank, Shop No. 4251, wt. 19 tons, 165 lb. steam pressure.
- 2—10x16 Baldwin, 36-in. ga., 4-wheeled Saddle Tanks. Wt. 19 1/2 tons. Shop Nos. 12161 and 28353.
- 1—9x14 Porter 36-in. gauge saddle tank. Shop No. 6960.
- 2—30-ton Climax Locomotives, 36-in. ga. New 1925.
- 4—7x12 Davenport and Vulcan, 24-in. gauge, 9-ton dinkies.
- 1—9-ton Whitcomb Gasoline, 36-in. ga. Shop No. 11593.
- 2—7x12 Davenport, 36-in. saddle tank. Shop Nos. 1566 and 1567.
- 1—12-ton Standard Gauge Whitcomb Gas, four-speed.
- 1—6-ton, 24-in. gauge Whitcomb Gas, gear drive.

DRAGLINE EXCAVATORS

- 2—Class 14 Bucyrus, steam operated. Shop Nos. 2140 and 3706, steel caterpillars, 60-ft. boom, 2 yd. bucket. A.S.M.E. boiler.
- 1—Class 14 Bucyrus, Shop No. 745, skids and rolls, 60-ft. boom, 2 yd. bucket.
- 2—No. 2 Monaghan steam operated. Shop Nos. 789 and 1587, skids and rollers, 60-ft. boom, 2 yd. Page bucket.
- 1—Model 105 Northwest, gasoline, 710 new 1925, 40-foot boom, steel caterpillars.
- 4—Koehring Crawler Draglines, Shop Nos. 337, 382, 384, and 453, gasoline, 40-ft. boom, 3/4 yd. Page Buckets. New 1925 and 1926.
- 1—30-B Bucyrus Shop No. 3641, steel caterpillars, 40-ft. boom, 1 yd. Page bucket.
- 1—Model 210 P&H Gasoline Dragline. Shop No. 1077 Armored caterpillars, 40-ft. boom, 1 yd. Page bucket.

All equipment overhauled in our Shop is furnished in guaranteed condition, subject to thirty days' trial in service.

SPREADER CARS

- 1—Standard gauge 100,000 lb. capacity Jordan All-Steel.
- 1—36-in. gauge Western Wood Spreader.

CRANES

- 1—Dock Crane, bucket operating, 50-ft. boom, 7 ft. 10 in. gauge, 12-in. wheel-base, capacity 15 tons at 18 ft. radius.
- 1—30-B Bucyrus, Shop No. 3922, steel caterpillars, bucket operating drums.
- 4—K-1 Koehring Crawler Cranes, Shop Nos. 337, 383, 384 and 453, 40-ft. booms, bucket-operating.
- 1—21-ton Industrial, 8-wheeled, Crane, Shop No. 2706, 50-ft. boom, bucket-operating.
- 1—Model 105 Northwest Crawler, Shop No. 710, 40-foot boom, 1 yd. Clamshell.
- 4—Type "B" Erie, 36-ft booms, bucket-operating, caterpillars.
- 1—15-ton Brownhoist 8-wheeled Crane. Shop No. 4520.
- 1—20-ton McMyler, No. 388, 50-ft. boom, bucket-operating.
- 1—18-ton Brownhoist, Shop No. 6583, 50-ft. boom, bucket-operating, A.S.M.E. Boiler.

BUCKETS

- 1—1/4 yd. Blaw-Knox "Dreadnaught" Clamshell.
- 1—3/4 yd. Williams "Favorite" clamshell.
- 1—1 yd. Owen Clamshell.
- 1—1 1/2 yd. O. & S. Clam Shell.
- 1—1 1/2 yd. Brownhoist Clam Shell.
- 1—1 1/2 yd. Mead-Morrison Clam Shell.
- 1—1 yd. Browning, Digging Type with teeth.
- 2—1 1/2 yd. Page Dragline Buckets.

MISCELLANEOUS

- 10—50 ft. Camp Cars.
- 1—10-ton Austin 3-wheeled Gaso. Roller.
- 1—No. 7-S Knickerbocker Concrete Mixer with power loader and water tank on trucks. New.
- 1—6 1/2 x 10 D.C., D.D. American Holst. with butt strapped boiler.
- 35—Milburn Carbide Lights.
- 1—No. 55 Buhl Portable Air Compressor.
- 1—Model 10 Keystone Mixer, low charger, 6 Hp. Novo Gas Engine.
- 1—No. 6 Keystone Mixer, 3 Hp. Novo Engine.
- 1—7x8 Gould triplex Pump, belt driven.
- 1—4x6 Fairbanks-Morse Duplex Pump with 7 1/2 hp. motor.
- 1—Buffalo-Springfield Roller, 10-ton, 3-wheel, No. 10707. New 1923.
- 1—Buffalo Pitts Steam Roller, 10-ton. No. 10049.

CLAPP, RILEY & HALL EQUIPMENT CO., 14 No. Clinton St., Chicago, Ill.

BECK, RILEY & HALL EQUIPMENT CO., 458 Union Trust Bldg., Pittsburgh, Pa.

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FOR SALE

Locos—S/T 80 ton 6 wh. 35 ton, 4 wh.
Crushers—Traylor 16x42 Mang. rolls P & M 42x40 jaw; No. 8K gates; two No 6 Williams hammermill.
Tanks—Four 8000 gals. horiz.-oil.
Cableway—2 Lidger; 1550 ft span 10 ton.
Cars—12 yd. S/G—8 yd 36" ga.
Kilns—Dryers 9 ft. x 100 ft. Vulcan; 7 ft. x 40 ft. Ruggles.
A. V. KONSBERG, 312 S Clark St., Chicago

CURTIS COMPRESSORS, HOISTS, CRANES, CAR WASH SYSTEMS, PORTABLE COMPRESSOR UNITS



The accompanying illustration reproduced thru the courtesy of the Moffat Tunnel Commission and the Denver Chamber of Commerce.

Curtis Air Hoists are adaptable to most every hoisting problem

Some of its many applications are:

Pulling ice cans in ice plants. Lifting automobile bodies, chasses and engines in automobile plants and garages. Lifting axles, wheels, trucks or armatures in steam or electric railway shops. Operating lifts on railroad unloading platforms. Lifting large flasks, large castings and heavy cores, operating furnace doors, in foundries. Operating freight elevators. Unloading material from cars. Handling structural steel. General material handling in production.

Curtis Cranes, Trolleys and Compressors are ideal for use in connection with Curtis Air Hoists.

Bridge cranes, jib cranes or any adaptation of either can be furnished. Curtis I-Beam Trolleys are made to run with the greatest ease while carrying the full loads.

Let Curtis solve your material handling problem.

Whether in the Moffat Tunnel or in your shop

The Curtis hoist illustrated above is playing its part in the gigantic task of cutting the famous Moffat tunnel. It was chosen by the engineers because compressed air is a logical material handling power and Curtis hoists are always dependable. Every day, year in and year out, it delivers steady, economical service.

Curtis Hoists will do as much for you, in your shop, material yard, loading platform, foundry or any place you wish to install it. The care and skill which have been put into its manufacture by the 73-year-old Curtis organization, have made it just that dependable.

Compressed air hoisting is most economical. The first cost of an air hoist is much less than that of any power lifting equip-

ment. If you have compressed air available, the Curtis hoist can be installed for about what a good chain block would cost. Depreciation is extremely low. Repair costs are almost nothing.

You will not need a skilled operator to handle your Curtis Air Hoist. Its movements can be directed with the closest accuracy by one of the men in the gang whose profit-eating labor it replaces.

Let us show you how a Curtis Air Hoist can be adapted to your lifting on material handling jobs. The coupon will tell us you are interested.

MAIL COUPON TODAY

CURTIS Pneumatic Machinery Co.
1969 Kienlen Ave., St. Louis, Mo.
Branch Office, 518-Z Hudson Terminal, New York

Please send me full free information about Curtis Cranes, Hoists and Trolleys.

Name

Address

☐ Also send information about Curtis Model "A" Compressors C-1

CURTIS PNEUMATIC

**HOISTS
CRANES
COMPRESSORS**

CURTIS PNEUMATIC MACHINERY COMPANY, ST. LOUIS, U.S.A.



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